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VIEWS, NEWS AND INTERVIEWS.

"Did I ever tell you about the great bluff I invented and worked off on a country hotel proprietor?" asked Meekin, the lazy inventor, as he tilted back his chair and lit his pipe. "It would have been blamed inconvenient for me if I hadn't brought my inventive faculties to bear on the subject and if I had neglected to observe the new telephone. It came about like this: I was making a flying trip through the West in search of a man who was said to have invented a process for tempering copper by electricity. One evening about dinner time I reached an Indiana town which I'll call Jayville, as the town is still there and so is the hotel proprietor. I rushed into the only hotel in the place, asked for some dinner and was shown to the dining room after I had registered. I wanted to catch the 9.13 train for Indianapolis so I could spend the night there. When I had finished my meal I fished around in my pockets for a dime to tip the waiter with. I found I hadn't a blooming cent in my clothes. You know I'm careless about money matters and never think of lucre until I'm out of it. Well, I hadn't any cash, but I had a $50 draft on New York in my pocketbook. I let the waiter go without his tip and walked out to the office where I found the landlord. I ostentatiously took up a pen, asked the landlord his name and made the draft payable to him.

"'Now,' said I, 'if you'll kindly take out the price of my dinner and give me the balance of this $50 I'll be obliged.'

"The landlord read over the draft forwards, backwards, sideways and upside down. Then he held it up to the light. At last he looked at me sharply and said:

"'Your name Meekin?'

"'Sure thing,' said I.

"'T. J. Meekin?'

"'Sure.'

"'How do I know it?'

"'You don't, but I'm telling you,' said I.

"'How do I know you ain't one o' these yere flim-flammers?'

"'You don't. Do I look like a flim-flammer?'

"'Wall, ye mought an' ye moughtn't,' was the landlord's encouraging reply. It was getting near train time and I was getting nervous. In glancing around the office with the faint hope that I'd see some one I knew, my glance fell upon a new long-distance telephone over in the corner. Right here was where I invented my bluff in Jayville at 8.45 P. M.

"'See here, Mr. Man', I said to the landlord, 'you know a bank draft when you see it, don't you? Well, that's a bank draft. Now it don't make any difference to you who I am if I can prove that the draft's good, does it? All right. I see you have a telephone. Can I use it?'

"'Ye can if ye know how to work the thing. Just put her in yistiddy an' I ain't on to the game yit.'

"'All right,' I replied. 'Now you come over there to the telephone with me and I'll soon satisfy you that your suspicions of me and this draft are all wrong.'

"We went over to the 'phone; the landlord leaned up against the wall watching my every movement. Luckily no one was around but an old man asleep near the stove and a stupid German porter. I picked up the receiver, without ringing, and this is what the landlord heard:

"'Hello, central! Gimme New York. * * * Hello! This New York? Gimme 3833 Cortlandt. * * * Hello! 3833 Cortlandt? Manhattan Exchange National Bank? * * * Mr. Crandall there? * * * Hello! This you Crandall, old man? This is Meekin. * * * M-double-e-k-i-n. Yes, Meekin, T. J. How are you? Say, I'm in Jayville, Ind. Hotel man says your draft number 347 on my account is no good. How about it? * * * Well? * * * Good for $5,000 is it? Sure? You are, eh? Good joke on your old bank, ain't it, Crandall? Cost you a bottle when I get back. Sure it's good, are you? Ha, Ha! That's good. Well, so long. See you next Monday.'

"With that I hung up the receiver, without ringing off, and turned to look at the landlord. His eyes were bulging out and when I asked him if he required any further proof he gasped out:

"'Wall, I swum to gracious! Ef that ain't the finest thing I ever see! Talking to New York, eh? Wall, I never thought to see it. Here, come over here and get yer cash. The dinner's on me. Never see anything so wonderful since the circus was here last.'

"I took the money, thanked him and nearly laughed myself into hysterics all the way to Indianapolis."

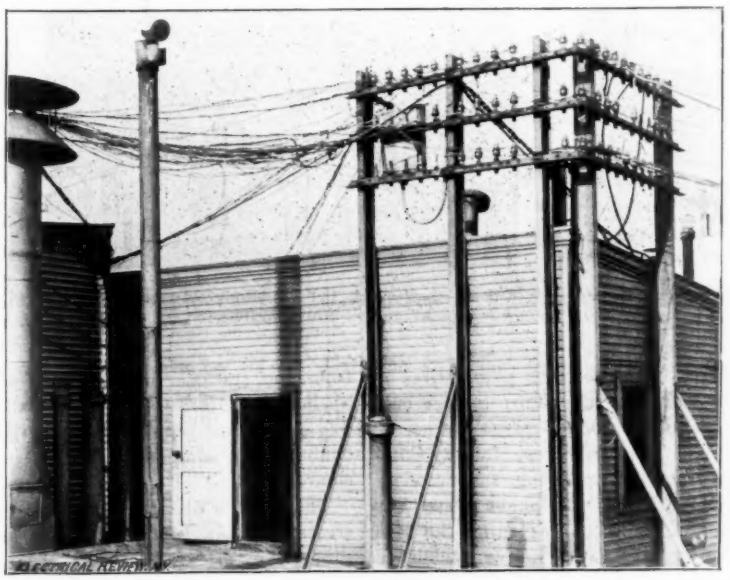

FIG. 1.—ONE FEATURE THAT THE INTERIOR BLOCK TELEPHONE SYSTEM AVOIDS.

THE INTERIOR BLOCK SYSTEM OF TELEPHONE WIRING.

A PROGRESSIVE STEP BY THE METROPOLITAN TELEPHONE AND TELEGRAPH COMPANY.

It has been known for some time that the telephone companies in smaller cities throughout the United States look to the Metropolitan Telephone and Telegraph Company, of New York city, for most that is latest and best in the way of improvements in the service. This company has just begun an innovation which promises important results and which will ultimately do away with nearly all overhead and house-top wiring of every description. As is well known, the Metropolitan company conducts its service on a system that is even now almost wholly underground and largely metallic circuits. Yet, in some instances, it has heretofore been nearly impossible to avoid running wires over roofs, either singly or in large numbers, on house-top fixtures.

The illustration, Fig. 1, shows a massive structure of this character on a building in New York city. The unsightly mass of wires is puzzling in its intricacy and the telephone circuits are mixed in with wires for other purposes. Naturally the chances for crosses, grounds and breaks are large. Another smaller, but scarcely less unsightly, house-top fixture is shown in Fig. 2, while the most modern type of this kind of fixture is illustrated in Fig. 3. This latter is made of jointed iron pipe and represents what is probably the limit of improvement in house-top work.

But even this is to be done away with finally when the Metropolitan company's new system is completed. This is called the "interior block" system of wiring and it is just what its name indicates. The diagram, Fig. 4, which is a plan view of an important business block in New York city, is almost self-explanatory.

The cable is run from the subway manhole M in the street in a pipe under the sidewalk to the basement of the Germania Building. It then runs along the basement ceiling to

A. From this point the cable is carried, in the areaway, along the rear walls of the buildings which front on Pine street. Small cable branches, which furnish service to the various buildings, are tapped on at the points indicated from S, to S_8. The terminals are shown at T, to T_{13}. The wires are run directly from the instruments to their respective house terminals.

The advantages of the interior block system of wiring are apparent at a glance. All the dangers of snow and sleet storms are obviated; in case of fire the firemen have no wires to cut or to hinder them in their work; consequently, the interruptions to telephone service from this cause are reduced to a minimum. One or more buildings in a block may be destroyed by fire, and in such a case there is but one cable to repair.

The Metropolitan company has on its engineering staff the best and most highly recognized talent obtainable and it is in just such improvements as these that its ability is demonstrated. The company intends to adopt the interior block system in all cases where the best interests of a rapid, efficient and constantly maintained telephone service demand it.

Electrical News From Canada.

On a visit to Montreal last week I found the absorbing theme was the suit of the Bell Telephone Company against the Montreal Street Railway Company. The Bell Telephone Company are suing to secure from the Street Railway company compensation for carrying out the return wire system in order that they might eliminate the trouble caused them by reason of the leakage of the railway return current on to their lines.

The Bell Telephone Company claim that this leakage made their service useless. To enable them to give a service that would be useful, they ran out a common return wire for each trunk route and branched this return to each subscriber, making practically a metallic circuit.

In doing this they, at the same time, obviated the necessity of introducing a metallic switchboard, as the common returns were connected to one another and to the ground at central office. The object in grounding the return system, which was insulated elsewhere for its entire length, was to reduce burn-outs between telephone people could have for damages, and aside from damage from electrolysis, would relieve the Railway company from any liability for damages by reason of their using the ground as a return.

In the first instance the Bell people will try to establish the fact of the Railway company not properly bonding and that they used the strap rails as a return without any return feeder to supplement it. The Railway company claim that the time allowed them in which they must have their system in operation did not allow of their putting down the most approved rails, bonds and return feeders.

The outcome of the suit will be awaited with interest. There were in attendance Prof. Dolbear, known as "Uncle Sam" from the likeness he bears and Dr. Crosby, Dr. Hutchinson and other well-known experts who appeared as witnesses.

Montreal is just awakening from its Winter's sleep, though the ice and slush make it very disagreeable underfoot. The Railway company operate all Winter, carting the snow away about 30 per cent for a renewal, and others are striving to show how much more economically they can light the city, or that the city can save money by embarking in the business themselves. The question is to be decided by the citizens by vote. The Street Railway company have acquired control of the Toronto & Scarborough Railway Company and now run cars to Victoria Park for one fare. They previously owned the Toronto & Mimico Company's lines, and now have but two independent lines in opposition, thus practically controlling the business. No other lines can enter the city because of the exclusive franchise enjoyed by the company.

We hear of proposed radial lines from Hamilton, London and other cities, which may develop into a reality during the coming year.

The Toronto Ferry Company who own the Hanlaur Point resort, are making extensive improvements and are introducing a complete electric light and power system, to be in operation the coming season.

The Ray Electrical Works of Hamilton, who have been in difficulties for some months back, have assigned, with preferred credits that will doubtless leave the real creditors on the outside.

Business generally and the electrical trade with it is showing a marked improvement.

The recent heavy fires will result in rebuilding, in considerable construction work being done, and in benefiting the local trade generally.

Your readable paper reaches us regularly, and the first column we find most interesting. The promoter of it, however, has developed an enviable proclivity in relating Munchausen yarns, of continuous comic elevation, that suggest the possibility of his having a motor in his head, run by alternating currents. He had better commutate it.

Have you had this one? "Father," said little Danny Grogan, "why dooze they have the electric light wires covered wit' rubber?"

"Oi am surprised at your ignorance," said Mr. Grogan in answer. "They do be covered so thot the light cannot lake out av um." T.

Toronto, April 5.

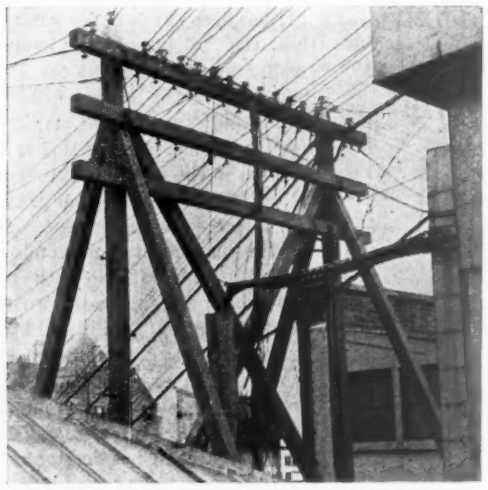

FIG. 2.—AN OLD-FASHIONED TYPE OF ROOF FIXTURE FOR TELEPHONE WIRES.

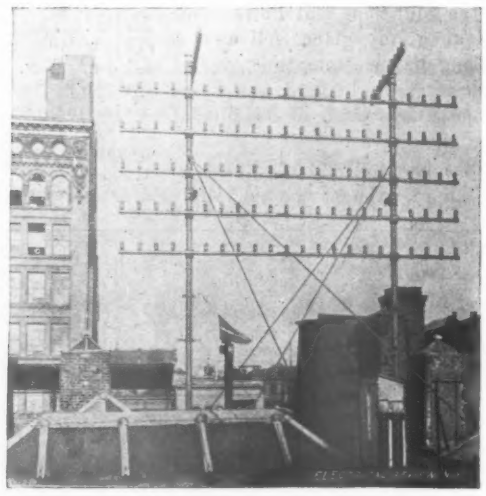

FIG. 3.—A MODERN TYPE OF ROOF FIXTURE FOR TELEPHONE WIRES.

ELECTRIC RAILWAY NOTES.

The Long Island Traction Company, of Brooklyn, N. Y., which recently went into a receiver's hands, has succeeded in raising enough money to pay the $300,000 quarterly rental of the Brooklyn City Railroad system. The directors of the latter company have declared a quarterly dividend of two and a half per cent.

Much work has been done in San Francisco, Cal., during the Winter on the street railway lines, changing them from cable or horse to electric roads. The overhead construction has been done almost entirely by the General Electric Company. This company is now at work on the main line of feeders from the power house, some 25 miles out of Sacramento, into that city.

The sub committee of the New York Aldermanic Committee on Railroads, which visited Baltimore last week to inspect car fenders and the rapid transit system of street cars, concluded its investigation on April 5. Since the car fender ordinance took effect, three months ago, not one fatal accident has been reported. The automatic life-savers have picked up uninjured nearly 50 persons.

cause of crosses with power wires by providing an easy return for the current to the ground.

The Montreal Street Railway Company, while deploring the necessity of the Bell Telephone Company making such charges, think the Bell Telephone Company have established a precedent in that several years before the advent of the Railway company, the Bell Telephone Company had introduced the common return, known as the "McClure system," to protect them from induction currents from electric light conductors, and also take the position that the grounded circuit system is not an *up-to-date system*. Lastly, and which is of more importance, in view of its probable outcome, is that the Railway company claim the ground as a common property, held in trust by the people and sublet by the people to various corporations, by way of franchises, to enable them to carry on their business.

This view, if sustained, would do away entirely with any claim the from the tracks. The opening of Spring brings forward numerous railway and other projects, which will doubtless see completion during the coming season.

The Temple Electric Company are erecting a new station under the supervision of Mr. Mashinter. He is erecting a very complete slate, bus and switchboard, and has introduced a novelty, in a four-way dynamo switch, for changing over. It rotates on a center to four different terminals arranged in a circle. This arrangement allows of throwing negative or positive to line, and into a high or low pressure feeder.

The electrical business generally has been backward, but as Spring opens all feel more hopeful.

In Toronto, the foremost topic is whether or whether not the citizens will vote for a municipal plant. The question of renewing the contract that still exists with the local company has been discussed pro and con for some months. The company have made a reduction in rate of

The Westinghouse Stopper Lamp.

The new glass factory of the Westinghouse Electric and Manufacturing Company is now in operation and has a capacity of 20,000 bulbs a day. The company has found a method of fastening the stopper in place by a vitreous substance which, it is said, makes a perfect joint. This process also enables the company to considerably reduce the cost of manufacture. The new lamp fits either a Sawyer-Man or an Edison socket. A small amount of platinum wire is used in the stopper, so that a sealing compound around the wire or in the base as formerly employed in the manufacture of stopper lamps is no longer necessary.

The Persons-Gerst Telephone Bill.

The final hearing on the Persons-Gerst bill to reduce telephone rates in New York State was held at Albany on Tuesday, April 2. The closing arguments against the bill were made by Mr. Shaw, counsel for the Commercial Telephone Company, of Troy, and Mr. Boardman, counsel for the Metropolitan Telephone and Telegraph Company, of New York. Mr. Sterne spoke again in support of the bill.

The case of the Troy company added another to the list of the smaller companies that have shown the committee that the bill has been drafted without the slightest knowledge of the conditions of their business. The bill would impose rates ranging from $27 to $36 a year whereas the average expense of operating each telephone throughout the Troy company's system is $51 per year. Further, it would impose the exclusive use of the most improved appliances, *i. e.*, metallic circuits and long-distance instruments; in country places this class of service is not necessary and subscribers are not willing to pay the rates that correspond to such service. Not a single subscriber from the company's territory had appeared or petitioned in support of the bill and no dissatisfaction had been expressed with the company's service or rates. Mr. Boardman made a powerful argument and scarcely left a point of attack untouched. Briefly put he showed that the friends of the bill had really no standing as applicants for legislation as they did not represent a sufficient number of subscribers—the only people besides the companies really interested—to lend any weight to their demands. The bill had aroused no support and no interest at all outside of New York city, Brooklyn and Buffalo. Although five hearings had been held within a stone's throw of an exchange of 1,400 subscribers, not a voice had been raised among the Albany subscribers in favor of the bill; and this in spite of every effort on the part of its friends to arouse sentiment in their support in Albany. The same result had attended their efforts in other places through the State; the question had been agitated, but the subscribers had not responded, and there was no dissatisfaction. Even in New York, Brooklyn and Buffalo, where there was some sentiment in favor of the bill, it was not widespread, and no substantial demonstration had been made that a large number, even a respectable minority, of the subscribers were interested. Although every subscriber had been plied with petition blanks, no petition in support of the bill had been presented. Those who appeared for the bill had to be content with making the best showing they could by citing the support of self-constituted associations with long-winded names. The committee would not be justified in seriously considering the bill on the strength of such hollow pretenses of a general demand for legislation. Considering the bill practically, it dealt with the companies with gross unfairness. Every company had presented figures showing that the rates named were below the actual operating expenses. The rates it sought to impose were from one-third to one-half the rates existing in other towns and cities throughout the United States. On this showing it was evident that the rates named in the bill were wholly inadequate, and that the present rates in New York State were fair and reasonable.

Treating of the bill as a legislative measure, Mr. Boardman held that it was without precedent in this State, and he twitted the legislature with enacting laws, at the dictation of self-constituted bodies, of which its members would later on be ashamed. In two other States only had such telephone bills been passed; in one, Indiana, the act had been repealed unconditionally at the earliest opportunity; in the other, Maryland, it had been modified at the request of its promoters and the rate had been raised. This particular bill was vicious legislation and against public policy, because it involved the delegation of legislative powers to a commission and gave the officers composing that commission judicial functions and authority.

In the course of his argument Mr. Boardman corrected various of Mr. Sterne's statements regarding foreign rates and service, and obliged him to withdraw his figures relating to the London system, which Mr. Sterne had only partially corrected in his letter to the committee. Mr. Sterne held to his statement that London subscribers get unlimited service with Paris for $200 a year, and Mr. Boardman read to the committee a telegram from London signed by Mr. Preece, saying that those subscribers pay full rates for each connection with Paris, just the same as any other user of the line. Altogether, Mr. Sterne's information on foreign matters was erroneous and misleading, and even if the facts had been correctly stated no fair comparison could be made between the European systems and the American, owing to the great differences in conditions.

Mr. Sterne spoke at length in reply, but made no attempt to rebut the arguments of the various counsel for the telephone companies, limiting himself entirely to attacking the rates of the New York company. He had nothing to do with petitions, and thought the legislature ought to take up the matter of its own accord, and dictate rates even if a single subscriber did not protest. He thought the Indiana law was a bad one and ought never to have passed, but his bill was a good one and ought to pass. He disbelieved all the figures that had been presented, and thought the companies ought to present their books, which would be a complete answer.

A Mr. McAdoo, of Yonkers, followed Mr. Sterne, and presented some curious estimates of the cost of telephone systems which he said had been made for him by an electrical engineer. He placed the total capital cost of a system for 400 stations, with switchboards, cables, pole lines, telephones and all complete, at about $32 per station, and he capped this by the statement that the average cost of operating in New York city should be about $29 per telephone.

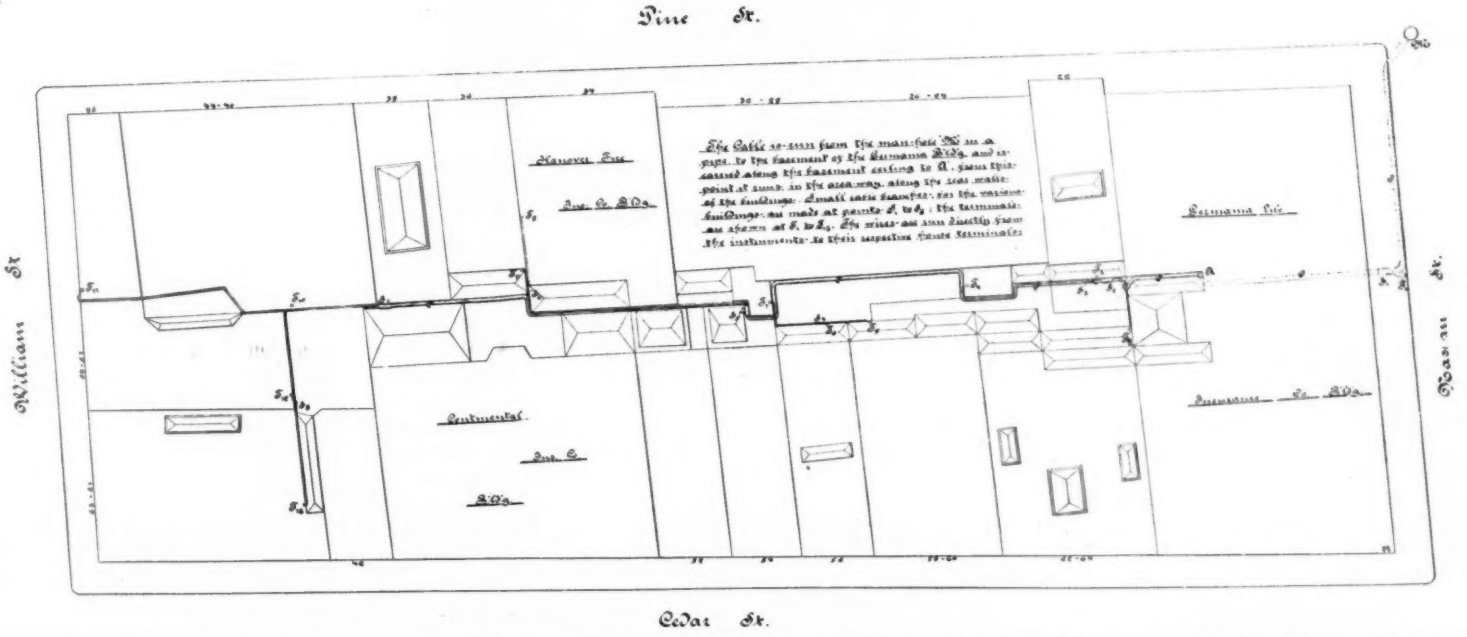

FIG. 4.—PLAN VIEW OF A NEW YORK CITY BLOCK, SHOWING THE INTERIOR BLOCK SYSTEM OF WIRING FOR TELEPHONE SERVICE, BY WHICH ALL OVERHEAD WIRES AND ROOF FIXTURES ARE DONE AWAY WITH.

ELECTRIC LIGHT FLASHES.

The arc and incandescent lighting plant at Hamilton, Mo., started service on March 28.

The recent report that the Oakland, Cal., Gas Light and Heat Company was in the market for $100,000 worth of new machinery is incorrect. The order has been placed and is now being filled.

The lighting plant at the State Industrial School for boys at Lancaster, Ohio, has been completed. The contract covered the erection of buildings, steam plant and both arc and incandescent lighting and was secured by the Franklin Electric Company, of Kansas City, Mo.

The Patchogue, N. Y., Electric Light Company recently declared a six per cent dividend, payable April 1. The following officers for the ensuing year have been elected: John S. Havens, president; Jesse C. Mills, vice-president; George D. Gerard, secretary; J. Henry Mills, treasurer. The executive committee consists of J. C. Mills, G. D. Gerard and H. J. Bishop.

Mr. L. Stieringer, who was consulting electrical engineer at the World's Fair, was in Atlanta, Ga., last week to advise with Mr. H. M. Atkinson, chairman of the Committee on Electricity of the Cotton States and International Exposition. He has been over the grounds, examining carefully their possibilities for electrical display, and has in process of development a new and original scheme for electrial effects on the lake. He has examined the maps and plans of the chief of construction with a view to perfecting the display, and thinks it will excel anything ever before projected.

The Sacramento-Folsom Power Transmission Plant.

The perfection of a system, by means of which power may be economically transmitted over long distances, which suddenly broadened the field of electrical effort, is now receiving practical and successful illustration in many places in this country, and our readers are familiar through our columns with the excellent work done at Taftville, Conn., Concord, N. H., Hartford, Conn., Columbia, S. C., and elsewhere. One of the best and most recent examples, and one of the most interesting, is the plant, nearly completed, which the Sacramento Electric Light and Power Company is constructing at Folsom on the American River, where one of the largest water powers in California will be utilized. It is the more interesting in that the scope of the scheme, which, at the commencement of the hydraulic work in 1866, was limited in its range, has been almost inconceivably widened by the alliance between water power and electricity, which modern invention has brought about.

The work as at first conceived embraced a dam across the American River near Folsom, and the utilization of the water primarily for power purposes; and, in the second place, for the irrigation of the surrounding country. The plan was modest in its proportions and remained so for many years, but the introduction of electricity immediately magnified it into a grand scheme contemplating the utilization of about 5,000 horse-power for transmission purposes, and 1,200 horse-power for use in the State prison, located by the side of a special State power house.

The first step was taken in 1866, when the foundation for the dam was laid. Some years later the California

FIG. 1.—THE AMERICAN RIVER NEAR THE DAM AT FOLSOM, CAL.

FIG. 2.—THE DAM AT FOLSOM, CAL., LOOKING FROM BELOW.

State government contracted with the power company, and in exchange for water power privileges and certain grants of land for prison buildings, agreed to supply convict labor. In 1888 a new contract was effected, the size of the dam and canals as indicated in the original plans was greatly increased, and under these new plans the work, pushed forward vigorously, is now rapidly nearing completion.

The dam is a massive structure of granite laid in Portland cement. It is 650 feet long, 89 feet high in the center, 87 feet wide at the base, 25 feet wide at the crest and contains about 48,590 cubic yards of solid masonry. It is provided with a heavy wooden shutter or flashboard six feet high, which at high water is lowered into a recess in the crest of the dam. At low water this shutter is raised by hydraulic pistons, the depth of the basin is increased by six feet and additional storage capacity for the waste water provided. Normally the dam forms a storage basin or reservoir three and one-half miles long and has a capacity of 13,000,000 cubic yards of water.

At each side of the dam are massive granite bulkheads and three head gates operated by hydraulic machinery, each head gate being 16 feet wide. The West Side canal is not yet completed, but is designed to be 40 feet wide at the top, 30 feet wide at the bottom and six feet deep. It is intended principally for irrigation purposes.

The East Side canal is completed from the dam to the site of the power house, a distance of about two miles. It is 50 feet wide at the top, 40 feet wide at the bottom and eight feet deep, having a capacity of about 87,000 cubic feet of water per minute. The canal, divided into three sections, follows the bank of the river for about two miles and is constructed partly of masonry, partly in deep solid rock cuts and partly by earth cuts and fills. Just before it reaches the power house of the Sacramento Electric Light and Power Company it has been widened into an immense log basin to hold the logs of the American River Land and Lumber Company, which company is about to erect at this point a large saw mill, to be operated entirely by electricity.

The power house of the Sacramento Electric Light and Power Company is situated at the extreme end of the canal, where a fall of 55 feet is available at high water. It is on the west side of the town of Folsom, where an immense cut in solid rock has been made, about 60 feet deep, 100 feet wide and 150 feet long, from which a channel of 40 feet wide leads to the river. In this cut the foundations for the machinery and the granite walls, piers and arches of a two-story building have already been laid and the structure is progressing rapidly.

At the power house the canal makes a sharp turn at right angles and widens out into a forebay 150 feet long, 100 wide and 12 deep, which forms a settling basin for debris. It is divided into two distinct parts by a wall provided with suitable gates so that one side may be cleaned out while the other is in operation. At the lower end of each section of the bay a sluicing gate connects with the lower river by a sluicing canal, and through these the sand and debris will be carried away and kept from the wheels.

The contract for the entire mechanical and electrical equipment was awarded to the General Electric Company in September, 1894. The contract for the hydraulic apparatus was let to the S. Morgan Smith Water Wheel Company. This apparatus will consist of four pairs of wheels of the McCormick horizontal shaft turbine type, enclosed in steel cases, having steel inlet pipes eight feet in diameter and double discharge tubes. By this arrangement in pairs, the end thrust is neutralized and sufficient power and speed is developed to allow of direct connection to the generators. The governors used will be of the Faesch-Picard type and will be supplemented with heavy fly wheels on the water wheel shaft. Each pair of wheels will have a capacity of 1,260 horse-power at 300 revolutions per minute. They embody all that is latest and most improved in hydraulic practice and are of larger capacity than any hitherto constructed in this country with one exception. They will be operated under a head of 55 feet. The hydraulic plant also includes two special horizontal wheels for the exciters. The water after having passed the turbines will be discharged through tunnels under the power house into irrigation canals for distribution over the country south and east of Folsom.

The generators will be four in number and will be of the General Electric three-phase alternating current type, generating current at 800 volts potential. The armature shafts will be directly connected to the shafts of the wheels by means of flange couplings. Each generator will have a capacity of 1,000 horse-power and will weigh about 30 tons. They will be the largest three-phase generators yet constructed.

The wheels and generators will be located on the first floor of the building, 16 feet above the level of the water in the tail race, but will not occupy the same room. Between the wheel room and the generator room a heavy masonry wall has been built. The openings through which the turbine shafts will pass will be small, and the wall will serve to protect the electrical machinery from the possible entrance of water. The water wheel regulators will be in the dynamo room, and the operator will thus have full control of the hydraulic machinery in sight of the electrical instruments on the switchboard. Both dynamo room and wheel room will be provided with traveling cranes.

In the second story of the power house directly over the dynamo room the sub-station step-up transformers will be installed. This is the standard type of transformers used by the General Electric Company in such installations. In these transformers the voltage, generated at 800 volts, will be raised to 11,000 and connections to the line will be made through marble switchboards equipped with the necessary switches and fuses.

Special provision to prevent shutdown by accident or unforeseen contingency has been made in the pole line, which will be double, from the Folsom power house to the Sacramento transformer sub-station, and will run along the line of the Sacramento and Placerville Railway as far as the city. Twenty-six hundred 40-foot round cedar poles 16 inches

in diameter at the butt are used for this purpose, and each will carry two cross-arms for two circuits of three wires each. Each circuit will consist of three bare copper wires supported on double petticoated porcelain insulators especially designed and made for this installation at the porcelain factory of the General Electric Company at Schenectady. Each insulator before shipment is exposed to a test of not less than 25,000 volts alternating. Each three-wire circuit can carry the output of one dynamo, and any dynamo can be thrown on any line, though they will all be operated in multiple. While repairing or testing a line may be cut out or grounded.

The sub-station will be a fireproof, two-story brick building, which will be divided into four parts: The step-down transformer room; the motor, railway and arc dynamo room; the shop and testing room; the store room.

In the transformer room the transformer switchboards will receive the terminals of the 10,000-volt transmission lines and operate the different combinations of the transformers. The step-down transformers, also of the air-blast type, will vary in size according to the duty required of them, and the secondaries can deliver current at 125, 250, 500, 1,000 and 2,000 volts for incandescent lighting and motor service.

In the main room will be three 300 horse-power three-phase synchronous motors of the standard General Electric type directly connected to a line shaft. This shaft, which will be provided with clutch pulleys, will drive several 500-volt continuous current railway generators and a number of arc dynamos.

The incandescent lighting, commercial arc lighting and stationary motor work in the central portion of the city will be effected on a low tension modified Edison three-wire system, by feeders from the secondaries of the step-down transformers supplying current to a net-work of mains. The motors will be of the three-phase induction type and can be connected to the mains at any point. The street and arc lighting will be done on the constant current series system, while outlying motors will be operated from higher potential lines with individual transformer reduction, or will be high potential synchronous motors.

Great credit is due to the ceaseless efforts and indomitable energy of the men who have brought this great enterprise to a successful conclusion, chief among them being Mr. Albert Gallatin and Mr. H. P. Livermore. The first, a prominent citizen of California well-known in connection with many successful undertakings, is president of the Sacramento company, while the latter, to whom the water-power came down as a family legacy, is general manager.

This installation will cover a practical transmission of power over a longer distance than has ever before been attempted. Embodying as it does problems of general distribution of electrical power for all uses over a distant city, it will attract attention in the world of science as well as in that of commerce as the most radical advance yet made in the electrical industry.

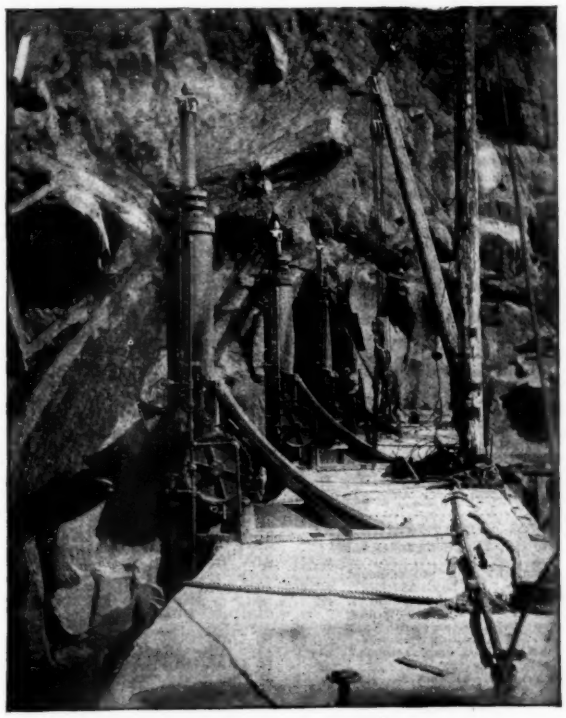

FIG. 3.—GATE MECHANISM ON THE FOLSOM, CAL., DAM.

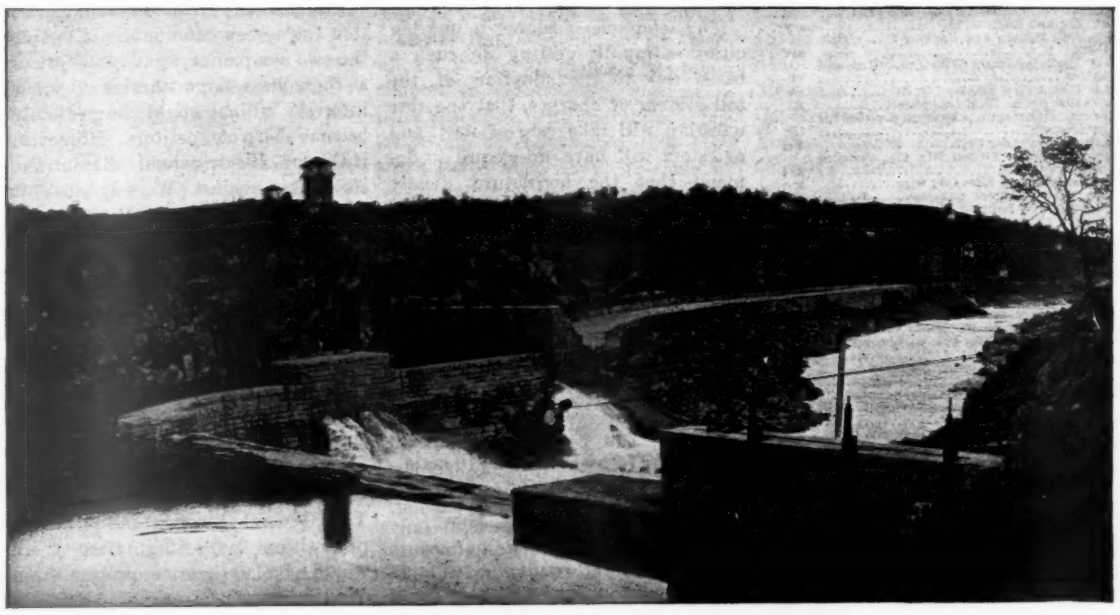

FIG. 4.—THE FOLSOM WATER POWER, LOOKING FROM ABOVE.

Since the drop in rates the Omaha exchange is experiencing quite a rush, 24 new subscribers for residence telephones having come to the office in one day. Manager Lane is experimenting with a sound expander for 'phones. If he carries it to the limit of usefulness it may be possible for employés of the Union Pacific auditing department to get returns from baseball games while they remain working at their desks.

TELEPHONE NEWS AND COMMENT.

The Tennessee House has passed a bill limiting telephone rentals in that State to not more than $3 per month for each instrument.

As soon as the weather permits, a telephone line will be built from Bath, N. Y., through Avoca, Cohocton and Wayland to Dansville.

The Mutual Telephone Company, of Petersburg, Va., has been granted permission to erect their poles and string their wires on the streets and alleyways of the city.

By a vote of 47 to 70, the Massachusetts House on April 5 refused to reject the bill taxing the American Bell Telephone Company on its shares held in foreign sub-companies.

Telephone rentals in Western New York, in nearly ever place except Buffalo and Rochester, have been reduced 10 per cent. Michigan has made a general reduction in city rentals of from 20 to 35 per cent. The Central Union Telephone Company has made a general reduction in its rentals averaging 25 per cent. This company operates in four States, Illinois, Indiana, Iowa and Ohio, and of all the Bell companies is meeting with the most competition, principally from the Harrison company.

A war is on in Kingston, N. Y., between the Hudson River Telephone Company and the West Shore Telephone Company. The latter is a new corporation which started out to get away the business of the former by giving the use of telephones to customers for $30 a year, while its older rival charged $5 a month. Now the Hudson River Telephone Company has cut the rate to $25 a year, and says that the new rates will not be changed after the cut-rate war is over. It is said that the West Shore Telephone Company will offer still lower rates.

The following are towns which have underground telephone wires. This list is not complete, but extensive enough to be interesting:

Albany, N. Y.; Atlanta, Ga.; Baltimore, Md.; Boston, Mass.; Bridgeport, Conn.; Brookline, Mass.; Brooklyn, N. Y.; Buffalo, N. Y.; Cambridge, Mass.; Chicago, Ill.; Cincinnati, O.; Cleveland, O.; Dedham, Mass.; Denver, Colo.; Derby, Conn.; Detroit, Mich.; Hartford, Conn.; Holyoke, Mass.; Lawrence, Mass.; Lincoln, Neb.; Louisville, Ky.; Los Angeles, Cal.; Lowell, Mass.; Milwaukee, Wis.; Minneapolis, Minn.; New Britain, Conn.; New Haven, Conn.; Newton, Mass.; New York, N. Y.; Niagara Falls, N. Y.; Omaha, Neb.; Philadelphia, Pa.; Pittsburgh, Pa.; Portland, Me.; Rochester, N. Y.; Salt Lake City, Utah; San Francisco, Cal.; Springfield, Mass.; St. Paul, Minn.; Orange, N. J.; Washington, D. C.; Wheeling, W. Va.; Wilkesbarre, Pa.

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Reports from various reliable quarters indicate that business is improving all over the country and that idle money is finding its way back into the channels of trade.

An important power transmission plant at Folsom, Cal., is described elsewhere in this issue. The engineering problems involved in the case seem to have been well and successfully handled.

TELEPHONE RATES.

With the final hearing on the Gerst Telephone Bill, an account of which we give on another page, the controversy between the telephone companies of this State and the supporters of the bill comes to an end. It is fairly evident that the bill has been drawn without proper knowledge of the telephone business, as the numerous objections made against it by the companies showed it to be unjust and impractical in all respects. The more eminent counsel engaged condemned the bill, lock, stock and barrel, arguing not only that it was arbitrary and unfair, but that if not unconstitutional, it was at any rate vicious legislation and against public policy.

The bill has been couched in ignorance and supported by misrepresentation. It was withdrawn for amendment after the first attack and a factitious claim for fairness and frankness was made by its authors on the strength of meeting criticisms by amendments that in reality only made confusion worse confounded. No showing was made that subscribers in any number were interested in the bill and absolutely no support was claimed outside of two or three places in the State, although the bill applies to the whole State and names rates less than half those that obtain throughout the country.

Only the general ignorance that prevails as to the conditions of furnishing telephone service and how much those conditions vary in different places, can be responsible for what interest has been aroused in this controversy, and the ventilation the subject has received during the discussion has gone far towards removing the mistaken impressions that generally exist.

The telephone business in our big cities is rapidly getting on such a basis, due to the adoption of the toll system of charges, that the rate question will take care of itself and agitators will have no excuse to demand that the legislature dictate rates. Under the present scale of the Metropolitan company, metallic circuit service can be had for $120 a year with a limit of 1,000 outward messages. This is $5 less than the rate named in the amended bill, and the arrangement meets the wants of the great majority of subscribers, who do not need more service than the amount furnished for the $ 20 rate.

No law can be passed that will compel the furnishing of a $10 article for $5. If an arbitrary flat rate, below the actual cost of operating, were imposed by law, it could only be met by the introduction of economies that would result in reducing the efficiency of the service. That is one of the laws of business and no statute drawn by legal skill could command any other result. The craze for cheapness can be carried too far. People who want cheap articles are catered to by all businesses, including that of supplying telephone service, but to impose cheapness on *all* the customers of any concern is ridiculous and must redound to the injury of the particular business, besides inconveniencing those who know what they want and are willing to pay for it. We hardly doubt that the legislators will arrive at the common sense view of the question.

WALL STREET AND THE ELECTRICAL STOCK MARKET.

THE GENERAL ELECTRIC–WESTINGHOUSE DEAL.

The market of the week was reactionary in tendency—a condition natural after the steady advance of 10 days or more. There was the usual realizing and some little attempt at bear activity, but values were rendered fair support and the general feeling prevailed that prices would be established on a higher plane. There are many signs which indicate that the bond syndicate has taken a prominent interest in the market. If this be true the tendency of prices will be upward and the advance as rapid as industrial conditions warrant. Trade reviews are more hopeful in tone, indicating an expansion in business. Prices, however, for the most part, do not improve.

There appears to have been a hitch in the deal between Westinghouse and General Electric. By some it is regarded as slight and may be smoothed over any day. The status of the matter, I am told on good authority, is as follows: The General Electric Company submitted an agreement covering details. It was accepted as satisfactory by Westinghouse. J. Jefferson Coolidge, a director of General Electric, representing quite a prominent Boston interest—among others President Coffin—it is said, refused to ratify the agreement which had been drawn up by his company. He is in the minority, however, and would, undoubtedly, have been called down ere this had it not been for the desire on the part of General Electric interests to maintain harmony in the board.

The minority, I understand, claims that the agreement would not enable the two companies to advance prices as there are a large number of other interests which would immediately become sharp competitors. Moreover, if General Electric should discontinue its suits against Westinghouse it would be forced to commence them against other concerns. As the matter now stands they are well advanced and their completion will settle the issues with all competitors. Consequently, in the opinion of the minority, it would be foolish to discontinue them at this time. I am also told that the cost of this litigation has not been 20 per cent of the amount claimed. In all probability the secret of the hitch is just this: The General Electric submitted its proposition expecting that there would be a vigorous protest from Westinghouse. Certain of the officers expected to get into the stock while the controversy was in progress. In this they were fooled, as Westinghouse accepted the proposition on the spot, and the stock shot up, leaving the officers out in the cold. All talk of a disagreement is calculated to weaken the market and facilitate the "getting aboard" process.

The General Electric report will be out about May 1. The directors are working on it daily. I am told that it will show rather heavy depreciations.

The stock has been a prime speculative favorite this week. It declined from 36 on Monday to 32¾ on Wednesday on realizations and talk of a failure of the negotiation with Westinghouse, and on Friday partially recovered. It weakened again Saturday. The bonds sold at 89 to 89½. They are sure to receive 2½ per cent interest June 1. At present figures they are cheap.

The franchise item of $8,159,264 in the General Electric Company's annual report of last year has been criticised as exorbitant. The opinion that this item is equitable is substantiated by the statement that last year it derived $400,000 in licenses and franchises.

Edison Electric Illuminating of New York was stronger this week, advancing from 97½ to 99. The stockholders will meet in special session May 1 at 53 Duane street to vote on the proposition to authorize the issue of $15,000,000 of bonds to be used as set forth in this column last week.

On the Boston Exchange, American Bell Telephone was steady up to Friday, when it dropped 3¼ points to 187, on the announcement of the organization of a gigantic opposition. On Saturday it went down to 182, a drop of 9 points. Electric Storage Battery was steady at 28 until the last of the week when it advanced to 29. Erie Telephone was stronger at 53½ to 54 against 52 on Monday. General Electric preferred lost 3 points in sympathy with the decline in the common stock on New York Exchange. On Friday it recovered 1 per cent. New England Telephone was firm at 72. Westinghouse securities were firm to strong. The common was offered at 35½, the preferred was bid 51 and offered at 52.

The New York and New Jersey Telephone Company has declared the regular quarterly dividend of 1½ per cent.

The Westinghouse company's new lamp factory is now capable of turning out 20,000 glass bulbs per day. I am told that the management expects to attain some fabulous results in the way of lessening costs.

Justice Beach has refused to make permanent an injunction restraining the officers of Interior Conduit and Insulation Company from issuing $500,000 gold debentures.

It is said that $15,000,000 represents the cost of Postal Telegraph property. In view of this fact, the increase of $5,000,000 to that figure is fully warranted. The course of the stock reflects that view inasmuch as it has been stronger since the announcement of the increase. Instead of issuing bonds against improvements, it has borrowed the money from directors and others and will now fund its obligations in an issue of stock. It has practically completed its extensions and has a compact, admirable plant for telegraph business. It has two routes through to the Pacific coast, northern and southern, and the lines are built in the most thorough manner, all previous experiences in construction being utilized, and all modern improvements have been adopted. The company has about 1,900 offices, about 18,000 miles of pole line and over 100,000 miles of wire. It has no bonded debt or fixed charges and is and has been for some time earning substantial dividends on the stock. Its close alliance with the Commercial Cable Company is of great value. I understand that in the near future the stock of the company will be listed on the New York Stock Exchange. BAIN.

New York, April 6, 1895.

OUR BOSTON LETTER.

The Standard Thermometer Company, of Peabody, Mass., whose announcement appears elsewhere in this issue of the ELECTRICAL REVIEW, are just putting before the trade their latest production in the shape of an arc lamp, which they claim surpasses all previous efforts. It is known as the "Upton" lamp, and is made for all circuits—direct current, constant potential, alternating and series. The experience and reputation of this company should stand them in good stead in the introduction of a new lamp, they having been engaged in the manufacture of arc lamps for incandescent circuits since 1888, when the first lamps for this service were turned out by them. They have in turn manufactured the "Simplex," "Ward" and "Knight" lamps, each showing a material advancement in the art, and the "Upton" is said to be still another step in the direction of progress. For some years past the Standard company was associated with the Electric Construction and Supply Company, of New York, and manufactured their entire product. The "Upton" lamp is considered a material improvement on the well-known "Ward" lamp, is much simpler in construction, cheaper in price and cheaper to maintain. The lamps are so constructed that they are waterproof without the use of hoods, and meet all the requirements of the fire underwriters. They consume four, five, six, seven, eight and 10 amperes at proper voltage. The factory and main offices of the company are located at Peabody, Mass., and are under the direct supervision of Mr. Henry G. Rice, president. The New York office is at 39 Cortlandt street, and is in charge of Mr. Charles A. Bramhall.

An arrangement between Assistant Postmaster-General Neilson and President Little, of the West End Street Railway Company, has been reached, by which the West End road will be used for carrying mail to a number of the outlying district offices, and a number of mail cars will be put into operation about May 1. The street car service of Boston is admirably adapted to this purpose, and will result in a great saving of time over the wagon system now in use. The entire district cannot, of course, be covered at once, but the principal stations will be handled first, and the service increased as rapidly as possible.

Judge Knowlton, of the Supreme Court, has ordered the sale on May 15 of the plant of the Woburn Electric Light Company, subject to the first mortgage of $35,000 and all encumbrances and liens, except the second mortgage and the receiver's certificates.

Among the orders received this week by the National Telephone Manufacturing Company, of this city, is one for 100 additional instruments from the Topeka Harrison Telephone Company, of Topeka, Kansas, and an order to equip the entire plant of the J. & P. Coats company, of Pawtucket, R. I., with National instruments. These orders merely corroborate my statement of last week that the "National" is by far the strongest instrument ever yet produced.

The Brodie Electric Company, of Manchester, N. H., reports a lively interest in their new automatic motor switch. This device combines the functions of the double-pole switch, adjustable limit switch and automatic cut-off in one piece of apparatus, and it is claimed infallibly protects the motor, with which it is installed, from burning out or other damage.

The Pettingell-Andrews company, Boston, Mass., are headquarters in New England for the well-known "Brodie" tree insulators, which are among the specialties manufactured by this concern. H. G. T.

Boston, April 6.

Test of the Niagara Falls Generator.

The first test of one of the big 5,000 horse-power dynamos recently placed in position in the power house of the Niagara Falls Power Company was made on April 5. A second trial was made the following morning before the officers of the Cataract Construction Company. Both tests were pronounced perfectly satisfactory. Among those present were President E. D. Adams, Vice-Presidents E. A. Wickes and Francis L. Stetson, and Secretary Rankin of the Construction company, all of New York. Others of the party were officials of the Erie Railroad and several English capitalists. The formal opening of the company's plant will not be held for some time.

Crocker-Wheeler Factory Burned.

The main factory of the Crocker-Wheeler Electric Company, at Ampere, N. J., was totally destroyed by fire last Sunday afternoon, involving a loss of about $250,000, covered by insurance. The fire started in the shipping department, and was discovered by the watchman, who attempted to fight the flames with a patent fire extinguisher, but in the end was compelled to call on the East Orange fire department. The only building saved was the japanning and enameling department, all else being destroyed.

The fire will cause no interruption in the business of the Crocker-Wheeler company, and the work of rebuilding will begin at once.

The Harrison Telephone Company has organized a branch at Sioux City, Iowa, and will put in a new system in about a month. This company, it is said, has already more subscribers than the old company.

The Standard Telephone Company.

The Standard Telephone Company, of New York, with offices at present at 68 Broad street, achieved considerable publicity in the daily press last week. It was reported that the company with its 50 sub-companies had a paid-up capital of $160,000,000. The company proposes to use among others the devices of Allen T. Nye. Just how the company proposes to establish itself in New York city has not been divulged.

The directors of the Standard Telephone Company are Thurlow Weed Barnes, president; John A. Brill, of the Brill company, car builders; Carl F. Baker, of H. Baker & Company, N. Y.; John W. Chandler, Boston; George Crocker, San Francisco; Senator Jones, Nevada; Henry Morse, New York; Allen T. Nye; Manning C. Palmer, Syracuse, N. Y.; Felix Rackemann, Boston.

Mr. Barnes, who seems to be the moving spirit in the company, says that the scheme has been brewing since 1893, but that the company's plans will not be made known until June. He says the parent company owns 25 patents. Last Friday Mr. Barnes gave out an official interview in which he said:

"We have over 200 prominent capitalists in the United States interested in the company. We propose to commence our service this Summer in New York city with a rate of $3 a month for telephones. We have purposely kept the matter very quiet for nearly three years until we had secured the franchises we wanted.

"It is true that Mr. Searles of the Sugar company is not a director of the company. He sold out day before yesterday. He was originally interested in the Standard scheme, but was bought out by the syndicate. Mr. Searles left last night for Arizona to be gone a month or more, but among those associated with the New York organization are his nephew, Ennis M. Searles, and his son-in-law, Winthrop Murray Tuttle. Mr. John E. Searles was president of the local company here.

"One of our counsel, Hon. C. H. Aldrich, who is the counsel also for Mylo G. Kellogg, who controls the only switchboard that can be used against the Bell patents, is now in this city with his client conferring with our people."

This week the company will move into offices in the Postal Building. Mr. John W. Mackay is said to be a stockholder in the Standard company.

A dispatch from Chicago says that the company will drop the price of telephones in that city to $25 per year and will operate in Chicago under a cosmopolitan franchise recently passed by the City Council. Actual work in laying wires will probably begin in Chicago within two weeks. The ordinance referred to was mentioned in the ELECTRICAL REVIEW for March 20, 1895, and it was then stated that prominent lawyers had declared it defective and that the courts would be asked to determine its legality.

Mylo G. Kellogg was for a number of years prominently connected with the Western Electric Company and took an active part in the formation of early local Bell companies in the West and South. He has now a number of suits pending against the American Bell and its licensee companies for adjustments of royalties and franchise stock. Allen T. Nye was at one time with the old Overland Telephone Company.

ELECTRICITY DIRECT FROM COAL.

READ BEFORE THE FRANKLIN INSTITUTE BY ALFRED H. BUCHERER.

The endeavors of scientists and inventors to convert directly the potential energy of coal into electrical energy have received a fresh incentive from the interesting experiments of Dr. Borchers. So alluring are the rewards that follow the solution of this problem that men known for their conservative attitude in similar questions have hailed with extravagant expressions of delight the seeming results of the German electro-metallurgist. It is true the latter deserves high credit for testing his ingenious idea; yet from his own account of the facts brought out in his experiments, I feel sure that as yet his endeavors have been fruitless. Such failure, it is only just to note, could not have been foreseen from the standpoint of our present knowledge of electro-chemistry. In the extensive discussion of Dr. Borchers' work, which appeared in various technical and scientific journals, one point has been altogether ignored, and this point is of such essential importance in the problem of the conversion of the potential energy of coal into electric energy that it deserves to be fully elucidated. This point is the relation of chemical to electrical energy. Dr. Borchers erroneously supposed that it would be possible to obtain an amount of electrical energy from the reaction $2CO + O_2 = 2CO_2$ that would be equal to the heat of formation of as much of the quantity of the reacting substances as take part in the transformation. Since von Helmholtz has shown that such a view does conflict with facts, it is no longer legitimate to assume its correctness, still less to base upon it efficiency calculations, as was done by Dr. Borchers and Ostwald (see *Zeitschrift f. Phys. Chem.*, 1894, p. 551).

The maximum amount of work which we can derive from a chemical reaction is a definite quantity, and is independent of the kind of energy into which it is transformed. Suppose we have an unpolarizable cell and make the external resistance extremely large as compared with the internal resistance; then, if the quantity m of electricity has passed through the circuit, a proportional amount of chemical action has occurred, and the heat developed in the external circuit is equal to the electrical energy obtained. On examination we will find now that although the internal resistance was vanishingly small compared with the external resistance, yet heat has been evolved or absorbed in the interior of the cell, and it follows from the law of the conservation of energy that the heat of reaction Q is equal to the electrical energy E, minus the heat q absorbed in the cell.

$$E - q = Q$$
$$E = Q + q \qquad (1)$$

q can have a positive value or a negative value, according to whether heat was absorbed or evolved in the cell. If we consider one electro-chemical equivalent involved in the transformation and measure Q and q in electrical units, then $E = Q + q$ where E measures the electro-motive force in volts. Von Helmholtz investigated the relation which q has to E by applying the second law of thermo-dynamics. The following reasoning is similar: We know that the mechanical energy of a perfect engine working between the temperature limits $T + dT$ and T is

$$dW = q\frac{dT}{T}$$
$$q = T\frac{dW}{dT} \qquad (2)$$

Now, since the second law of thermo-dynamics holds for the transformation of heat energy into any other form of energy, it must be true for the transformations occurring in a galvanic cell. Now, as mentioned above, the electro-motive force of a cell measures the energy, if we consider the amount of transformation effected by one electro-chemical equivalent, *i. e.*, the work done by the passage of one coulomb. We can, therefore, substitute dE for dW and we have by substituting dE in (2)

$$q = T\frac{dE}{dT}, \qquad 3)$$

and, therefore,

$$E = Q + T\frac{dE}{dT}. \qquad (4)$$

$\frac{dE}{dT}$ is the temperature co-efficient, and it follows that if the electro-motive force of a cell increases with temperature $T\frac{dE}{dT}$ is positive, and the electro-motive force is larger than the value calculated from the heat of transformation, and heat is absorbed in the cell; whereas, if the electro-motive force decreases with temperature, the electro-motive force is smaller than the value Q expressed in electrical units. Heat is evolved in the interior of the cell. Now, in some primary cells the temperature co-efficient is so small that it can be practically neglected; in others, it is so great that the electro-motive force, as calculated from the heat of formation, will give a decidedly wrong value. With a reaction that is so different from those utilized in ordinary cells, and concerning which we know so little, as the one utilized by Dr. Borchers, it is not legitimate to form any conclusions as to the electro-motive force obtainable.

The question now presents itself, what is then the maximum electro-motive force we can expect to gain from the combination of carbon monoxide with oxygen? Is there any reversible transformation, no matter into what kind of energy, about which we do know something? There is such an ideal process, and I will show the reasoning by which we can arrive at the desired value. The reasoning is based on the principle of the dynamical equilibrium of chemical systems, which principle is nothing else than a disguised form of the second law of thermo-dynamics. When carbon monoxide combines with oxygen, not all of it is thus oxidized, and at a definite temperature and pressure the composition of the resultant mixture of gases, consisting of CO_2, CO and O_2, is definite. Deville found experimentally that at a temperature of 3,000 degrees Celsius, 40 per cent of the carbonic acid is dissociated at atmospheric pressure. I have calculated from this fact that at a temperature of 0 degree Celsius and atmospheric pressure the fraction of dissociated CO_2 is $\frac{1.58}{10^{34.86}}$.

If we conduct the process of combination of CO and O in such a manner that the maximum amount is being obtained, and take care that the temperature does not change, then this work depends on the initial and final condition of the gases. Now, let us suppose two-gram molecules of carbon monoxide, *i. e.*, 56 grams at atmospheric pressure, react on one-gram molecule, *i. e.*, 32 grams of oxygen, also at atmospheric pressure, in a reversible manner, and that the carbonic acid formed is likewise brought to atmospheric pressure, then, evidently, since, as we have seen, the dissociation of the carbonic acid is extremely small, the partial pressure of the carbon monoxide in the product of the reaction must also be very small, and the carbon monoxide, while performing work, has been brought from the atmospheric pressure to an exceedingly small pressure. Now, if the partial pressure of the CO be p_1, then the work done is

$$W = 2RT\log_e\frac{1}{p_1},$$

where R is the gas constant referring to one-gram molecule of gas and is equal to 1.98 calories. The oxygen is similarly brought from the atmospheric pressure to a partial pressure, which is one-half of the partial pressure of the carbonic oxide; for the gases being present in the ratios in which they react on each other, two volumes of CO are present to one molecule of oxygen, and the pressure of the carbonic oxide is twice that of the oxygen. Hence, the work performed by the oxygen is

$$RT\log_e\frac{2}{p_1}.$$

Since the carbonic acid in the reaction mixture is practically under atmospheric pressure, no work appreciably is done upon it, and the total energy obtained by the reversible combination of the two molecules of CO with one-gram molecule of oxygen is

$$W = 2\,RT\log_e\frac{1}{p_1} + RT\log_e\frac{2}{p_1}$$
$$W = RT\log\frac{2}{p_1^2}. \qquad (5)$$

Since now the fraction of the CO_2 that is dissociated at 0 degree Celsius is

$$\frac{1.58}{10^{34.86}}$$

it follows that the partial pressure p of the CO is

$$\frac{1.58}{10^{34.86}}$$

atmospheres. Substituting this value in equation (5) we have

$$W = RT\log_e\frac{10^{104.58}}{2}.$$

This energy refers to the chemical combination of two-gram molecules, and is expressed in calories. To obtain the energy for the combination of one electro-chemical equivalent, expressed in electrical units, we divide by 4×23039, and we have

$$E = \frac{1.98 \times 273}{4 \times 23039}\log_e\frac{10^{104.58}}{2}\text{ volts.}$$

$$E = 1.41\text{ volts.}$$

This is the value for 0 degree Celsius. The heat of formation of carbonic acid is 68,000, and the electro-motive force calculated from this is 1.476. Therefore, by the equation of von Helmholtz,

$$1.41 = 1.476 + 273\frac{dE}{dT}$$
$$\frac{dE}{dT} = -\frac{0.066}{273}.$$

The electro-motive force, therefore, decreases by

$$\frac{0.066}{273}$$

volts, with every increase of temperature by one degree. At the standard temperature, 18 degrees Celsius, the electro-motive force is, therefore,

$$1.476 - 291\frac{0.066}{273}$$
$$1.476 - 0.07 = 1.406.$$

We thus see that the electro-motive force is somewhat smaller than assumed by Dr. Borchers. The greatest electro-motive force obtained by Dr. Borchers was 0.5 volts. The conclusion which he now draws from this result is that he has already succeeded in obtaining about 30 per cent of the energy of the coal, whereas the steam engine converted much less. This is another non-admissible conclusion, for, in an unpolarizable, *i. e.*, reversible, cell, the maximum electro-motive force is a definite value, and if another value is experimentally observed, which very appreciably differs from it, then, barring secondary actions, the reaction which is expected to furnish the electric energy does not occur. To say that secondary actions depress the theoretical electro-motive force is not logical in this case, for, evidently, this secondary electro-motive force would have to be about twice as great as the observed electro-motive force, and, therefore, could not be called secondary.

The action that took place in Dr. Borchers' apparatus is most probably one that can be found among those which were investigated and published by Mr. Mond (see London *Electrician*, January 11). It would lead too far to discuss in detail the work of Mond, and to single out the particular action to which the electro-motive force of the apparatus of Dr. Borchers was due.

For reasons which were well stated by the latter, it is more expedient and apparently easier to utilize the combination of carbon monoxide with oxygen for the generation of electric energy, instead of that of carbon with oxygen. The work done by Dr. Borchers, though not crowned with success as yet, is, nevertheless, of high value on account of its instructiveness. It indicates in its general features the path that has to be followed for accomplishing a most important industrial task, the fulfillment of which we hope this century will yet witness.

ITEMS OF INTEREST.

The Harrison system is reported to be furnishing satisfactory service to 225 subscribers at Norwalk, O.

The Ohio Harrison Telephone Construction Company is equipping Wadsworth, O., and has the first 100 'phones talking in Massillon and 150 in Toledo.

An effort is being made to organize a local telephone exchange in Pittsfield, Me.; and as soon as the local service is thoroughly perfected, it is the purpose to establish a long-distance line to Waterville.

Beecher Smith, proprietor of the Somerset Ice Company, has been granted a franchise for a telephone exchange in Somerset, Ky. It is reported that 75 subscribers have already been secured. Mr. Smith wishes to correspond with manufacturers of telephones.

A new telephone company has been formed to furnish Augusta, Me., and Gardiner with cheap telephone service. The New England company, which now has exclusive control, will, it is reported, thoroughly perfect its system, and will also drop its rates from the present figures to $1.50 per month.

THE BUDA-PESTH UNDERGROUND RAILWAY SYSTEM IN WASHINGTON, D. C.

THE METROPOLITAN STREET RAILWAY COMPANY AGAIN APPEARS AS A PIONEER.

The Metropolitan Street Railway Company, of Washington, is once more in the field as the enterprising pioneer in a new scheme of electric traction. Three years ago the company invested $360,000 in storage battery experiments which resulted in complete failure. Of this amount something like $250,000 went to pay for buildings and steam engines which are available for future use. Of the accumulators themselves, a large quantity of scrap lead was recently carted to a smelting furnace and nothing now remains but a pungent aroma of sulphuric acid which pervades the cars they burdened but failed to propel. To the company the experiment brought a serious loss; to the American public it gave incalculable benefits. When the facts concerning the experiments were made known through the ELECTRICAL REVIEW storage battery traction was a dead issue and many capitalists saved the money they contemplated investing in it.

The new plan of the Metropolitan Company is to equip the road with a metallic circuit subway line, substantially like the Buda-Pesth system, which has, for so many years, been held up as the perfection of street railway traction, but which has never been duplicated in Europe or anywhere else. An explanation of this seeming inconsistency has often been asked but never given.

The present undertaking is backed by $700,000 in ready money, the resources of the General Electric Company and the well-known engineering ability of Mr. A. N. Connett. The company has gone into it purely as a practical business matter, without any of the clap-trap that has characterized so many of the conduit schemes. This spirit of enterprise is considerably stimulated by an act of Congress which compels the company to adopt some underground system on its Ninth street line, and have it in operation by the second of August, 1895. The main line is to be changed later on.

All the subway and surface work is being done by Mr. E. Saxton, and this is equivalent to saying that it will be done well and rapidly. Mr. Saxton has constructed all the cable roads in Washington, besides many others in Baltimore, Kansas City and other places in the West, and is fully equipped for the business. Samuel L. Phillips, the administrative officer of the company, has a reputation for getting street railroads out of difficulties and putting them on a sound financial basis. He is a Washingtonian, 56 years of age, a graduate of Princeton College, a very able lawyer and successful financier. In 1873 he was the president of the Washington and Georgetown road, and from 1875 to 1879, president of the Third Avenue road in New York city. When he assumed control of these companies they were in debt and operating at a loss; when he left them they were earning large dividends and had a cash surplus on hand. His first executive act in the Metropolitan was to reduce his own salary; the second was to stop dividends which were being paid out of borrowed money. He has given careful and thorough study to the subject of motive power for his road, and is leaving nothing undone to make it a success. Mr. Connett, the chief engineer, is in charge of all the mechanical and electrical work, in which he has had much practical experience.

The line now under construction extends from the Potomac River to the northern boundary of the city and is a double track road four miles long. It has about a dozen moderate curves, and its maximum grade is three per cent. It intersects the busiest section of the city and crosses three cable lines.

The construction is, in the main, identical with that of the ordinary cable lines. The conduit, however, is only 24 inches deep, while most of the cable conduits are 39 inches. The track is laid with 83-pound steel rails, seven inches deep. The electric conductors consist of angle irons in 27-foot lengths, weighing 23½ pounds per yard, with a conductivity equal to 400,000 circular mils copper. They will be hung from porcelain insulators, four inches in diameter, placed 13½ feet apart. These insulators and their iron casings are set in place from the surface of the street and can be readily and separately removed and replaced. The conductor irons will be slipped into the conduit through narrow pockets in the slot-rail 500 feet apart, and snaked along to their places. They will be fitted with expansion joints and flexible copper bonds. Any section can be removed without disturbing anything else. In designing the road quite a number of new features have been devised by Engineer Connett and patented by the company. Provision has been made for easily substituting a cable should it for any reason ever be found desirable. Ample drainage for the conduit will be provided.

A 10-way terra cotta conduit of the Lake pattern will be laid along the track to carry the necessary feeder cables. Wire made by the General Electric Company will be used, and 35,000 feet of 1,000,000 circular mils and 32,000 feet of 500,000 circular mils will be required. It will have a covering of five-thirty-seconds india rubber and one-eighth lead with an insulation resistance of 750 megohms per mile. The manufacturers guarantee it to last five years.

The power station is located on the river bank at the southern end of the line, where coal can be landed from boats and a free water supply is obtainable. The power will be furnished by three 400 horse-power tandem compound engines, each connected direct to a 300-kilowatt General Electric dynamo capable of generating a current of 500 volts. The motor cars will each be equipped with two 25 horse-power General Electric motors.

The first half of the line, two miles long, will be worked direct from the station; beyond that distance feeders will supply the current at suitable intervals. The eastern section of the main line, two miles long, running from the F street crossing, past the Capitol, and out to the eastern edge of the city, will eventually be operated from the river station. The western section of this line will be operated from the Georgetown station.

Before the reconstruction of the main road is undertaken the company and the country will have the benefit of the experience gained in carrying out the project now in hand. Within the next four months important questions will be settled. President Phillips has met the demand of Congress squarely and will indulge in no half-way measures. In planning and equipping his road he has secured the

A. N. CONNETT, CHIEF ENGINEER METROPOLITAN STREET RAILWAY COMPANY, WASHINGTON, D. C.

aid of the best men to be had and the entire work will be done well. *The cars will go*—whether they will return laden with profits for stockholders is a question of vital interest, and it is at present unanswerable. It is to the interest of the electrical industry that the answer shall be favorable. And it is about time that electrical men should consider the subway problem candidly. Now that its opponents have knocked the fruit off the highest trees with their trolley poles their hostility will doubtless diminish. One point which is receiving the keen attention of railway men is the necessity of having conduits so constructed that they can readily be utilized for cable, electric or any other power which may in the future be found most practicable. Fifty thousand dollars a mile is a large investment to put into a conduit road which is limited to the use of a single system, when there is a chance that a much better one may soon be devised.

G. C. M.

Washington, D. C., April 5, 1895.

Who Makes Castings?

An esteemed subscriber of the ELECTRICAL REVIEW wants the address of some firm that makes castings for a first-class 110-volt dynamo, in sizes from 50 or 60 lights down. He wants working drawings, too. We shall be glad to hear from any such firm.

GENERAL NOTES.

W. J. Creelman, of Rochester, N. Y., is placing a 500 horse-power simple condensing Philadelphia Corliss engine in the power house of the Citizens' Light and Power Company of that city.

The American Bell Telephone Company is reported to have made reductions in the rental of transmitters, which effect a yearly saving of $75,000 to the Erie Telegraph and Telephone Company and about $100,000 to the New England Telegraph and Telephone Company.

The Commercial Electric Light and Power Company has been notified by the Board of Public Works of Tacoma, Wash., to remove its wires from the city's poles within 60 days. Commercial wires are now attached to about 200 city poles. The company a year ago refused to take down its wires because of a contract with the old water company. This contract is said to have expired.

The Port Jefferson & Patchogue, L. I., Electric Railroad will be incorporated in a few days. Rights of way have nearly all been secured. The capital will be $150,000. John Roe Smith, O. F. Fanning, Dr. Chambers, of Port Jefferson; Geo. D. Gerard and J. C. Mills, of the Patchogue Electric Light Company, are the chief promoters of the movement.

Arrangements have been completed for the lighting of the grounds of the Cotton States and International Exposition, at Atlanta, Ga. A large number of arc and incandescent lights are included. Under the plan outlined by Mr. H. M. Atkinson, the grounds will be beautifully and brilliantly lighted, and the electrical display will be very complete. Exhibits will be made by a number of companies, and the General Electric Company proposes to eclipse all its former displays.

A successful test of the electric lighting installation on the Brooklyn Bridge cars was held last week. A train of four cars, equipped with 10 lights in each car, was run from 6 o'clock until late one evening without a hitch. President Howell and a number of the bridge trustees rode back and forth on the train, and representatives of the Electrical and Mechanical Engineering Company, which put in the plant and must operate it successfully for 60 days before it will be accepted, were also on hand.

President Benjamin Norton and Superintendent Daniel Quinn of the Atlantic avenue railroad system Brooklyn, N. Y., who were on trial for three days last week in the Court of Sessions, Brooklyn, on a charge of having violated the 10-hour law by making their employés work more than 10 hours within 12 consecutive hours, were acquitted on March 27 by the jury, who had the case under consideration for just 39 minutes. The suit was the outcome of the great trolley strike. A number of the managers of the strike decided that President Norton and his superintendent could be sent to jail for violating the 10-hour law. Jeremiah Desmond, one of the old conductors, was made complainant.

Conductors and Insulating Compounds.

In the interminable endeavor to procure a perfect dielectric or insulating compound, man, with unstinted hand, has drawn upon the sea, the air, the earth, upon the animal, the vegetable and the mineral kingdoms; in fact, upon the vast storehouse of nature for his material and with almost unvarying results. He produces mysterious compounds of still more mysterious ingredients, of known with unknown substances, of gum and grease, rubber and resin, butter and brass, silk and soda, calico and cod-liver oil, until it becomes necessary for the inventor not only to originate the compound, but a name for the product as well, and nobly has he discharged his self-imposed obligations. The archives of that vast and dolorous graveyard of misdirected efforts and blighted hopes, the Patent Office, crowded to repletion with the records of what his ceaseless industry has accomplished, attest his courage, his hopes, as well as his failures and successes. The ghost of 1835 in the guise of a patent rises to confront the youth of 1895 who has struck the same rich vein of prospective success, honor and wealth which the earlier searcher found and patented, and for this the youth fails to secure official recognition of his skill and inventive genius, quite equal, no doubt, to that displayed by the 1835 man, but a little behind the age.

Neither has the man in quest of a conductor upon which the various compounds may be placed been idle, although as compared with the "compound man" his meager record is indeed forlorn. Nature has considerately provided a fairly good conductor, however, and upon this the industrious inventor has thus far found it difficult to improve.

In searching the records for other data, the following substances, used singly or in various combinations, were noted as named in patents granted either for insulating compounds or conductors, and the list, although incomplete, is interesting, indicating, as it does, directly the wonderful amount of research in the direction of "insulation," and indirectly, the opportunities still offered in this important field of study and invention.

Beginning with conductors we find aluminum and its alloys:

Bronze core, copper exterior.
Copper core, bronze exterior.
Copper wire covered with silver.
Copper wire, silver plated.
Copper wire plated with bismuth, tin, iron, lead, brass, antimony, nickel and german silver.
Tin copper wire wound around a core of steel.
Interior core of steel, iron or aluminum bronze.
Iron core sheathed with copper.
Iron or steel wire coated with a mixture of lead, antimony and tin.
Metal bands.
Phosphor bronze.
Platinum core in copper cylinder.
Steel core with covering of wrought-iron.
Strands of fine wire inclosed in tube and drawn down.
Wires, nickel plated.
Wire, braided in hollow tubes.
Water (pure) in rubber tube.

For "insulating compounds" the following are named:

A

Alum.
Albumen.
Androba oil.
Asbestos.
Anthracene.
Arsenic.
Any fluid matter.
Artificial stone.
Animal hairs.
Any suitable material of light texture.

B

Bichloride of mercury.
Brimstone.
Black oakum.
Bamboo.
Bees-wax.
Baked earth.
Bituminized paper.
Borax.
Bichromate of potash.
Bran.
Baked potters' clay.
Baryta.
Bromine.
Burnt clay.
Beef suet.
Blue butter.
Bones.
Benzine.
Benzole.
Boiled oil.
Bitumen.
Beads.
Brunswick black.
Black varnish.

C

Coal tar.
Continuous vacuum.
Cardboards.
Cement.
Cellulose.
Creosote.
Cloth.
Calico.
Canada balsam.
Coir rope.
Cotton.
Corvine.
Chondrine.
Colline.
Casein.
Copper soap.
Chloride of sulphur.
Cork.
Canvas.
Calcareous matter.
Camphine.
Chloride of sodium.
Carbonate of soda.
Carbonate of lime.
Cotton seed pitch.
Chlorine.
Cholaphine.
Cane and fibre.
Coal naphtha.
Cotton seed oil.
Camphor.
Carbonate of lead.
Cod liver oil.
Collodion.
Chapapote.

D

Distilled tar.
Dry air in pipes.

E

Enameled gutta percha.
Elastikon.
Earthenware blocks.
Enamel.
Euphorbia gum.
Elastic fibrine.
Earthenware pipes.

F

Furnace slag.
Flour silicate of potash.
Foots of cotton seed oil.
Farina.
Fatty varnish.
Fibrous cords.
Fillets of sheet metal.
Filamentous matter.
Flannel.
Flowers of sulphur.
Flax.
Flour of glass.
Felt.
French chalk.

G

Gum balata.
Glass.
Ground shells of cocoanut tree.
Gelatine.
Gutta percha.
Gun cotton.
Gold size.
Gas tar.
Gum mastic.
Graphite composition.
Gambier.
Glass beads.
Gum thus.
Glycerine.
Gypsum.
Grease.
Green hide.
Glass pipes.
Green glass powdered.

H

Hemp.
Hemp seed oil.
Hair.
Horse hair.
Hessian.

I

India rubber.
India rubber (native).
India hemp.
India grass.
Iodine.
Iron filings.

J

Jeffreys Maine glue.
Juice of susupoka trees.
Juice of milk tree.
Judean gum.
Japan.

K

Kauric gum.
Kamptidicon.
Koolin.

L

Leather.
Limestone pulverized.
Lead foil.
Linseed oil.
Lampblack.
Linen.
Lead.

M

Metallic tape.
Manilla.
Marine glue.
Milk of sulphur.
Mica.
Mercurial salt.

N

New Zealand gum.
Network of hairs.
Naphtha.

O

Oil of turpentine.
Oxide of manganese.
Oil residue.
Oxide of zinc.
Oleic acid.
Oil of petroleum.
Orcausson.
Oxide of lead.
Oak bark.
Oxide of cobalt.
Ozokerite.

P

Paper.
Poisonous substances.
Pitch.
Paint.
Powdered glass.
Porcelain beads.
Patent driers.
Powdered charcoal.
Phosphorus.
Powdered chalk.
Phosphoric acid.
Potash.
Paraffined cotton cord.
Paper pulp.
Petroleum.
Powdered flint.
Puzzdanas.
Palun oil.
Paraffine butter.

R

Refuse of animal hides.
Ribbons.
Rattan.
Rubber cloth.
Red Lead.

S

Schist oil.
Silicia acid.
Sugar of lead.
Silicate of soda.
String of tinfoil.
Straw.
Sulphur ointment.
Sheet brass.
Slag wool.
Sem grass.
Spermaceti.
Sea sand.
Stone ochre.
Strips of cane.
Strips of metal.
Saline earthy substances.
Sliced cane.
Slag.
Slate.
Shoddy.
Styrax.
Sem cloth.
Sand and pitch.
Stockholm tar.
Soap.
Sulphate of copper.
Spun glass.
Silicate of magnesia.
Silk noils.
Silk.
Shellac.

T

Thread.
Taneo threads.
Tannin.
Tar oil.
Toffetas.
Twine.
Tallow.
Trinidad pitch.
Tow.
Terra japonica.
Tube filled with water, glass.
Tinkle.
Tan bark.
Tale.
Tungstic acid.
Tar thickened with wood dust.
Tough wood.

U

Unbleached cotton.

V

Venice turpentine.
Varnish.
Vegetable fibre.

W

Wood.
Washers of india rubber.
Waterproof cement.
Wheat flour.
White arsenic.
Woolen cloth.
Welsh spar.
Wire gauze.
Wood fibre.
White lead.
Wet yarn.
Wrong way yarn.
Whale bone.
Waxed thread.
Wax.
Water resisting medium.
Weavers' waste.
Ways mixture.
Wood tar.

X

Xyloidine.

Y

Yarn.
Yarn and wire.
Yellow orpenient.
Yarn saturated with tar water.

Z

Zopissa.
Zinc white.
Zapote gum.

Many of these substances will be recognized by "the trade" as the old reliables, others as new and strange—but in the list are included some items which thus far have produced results that mark the nearest approach to perfection yet attained. The struggle for final victory is still going on and in a few years this list could be extended to twice its present length and yet fall far short of naming all the "compounds" brought into use in the effort to produce a cheap and perfect dielectric.

B. & L. Overhead Railway Specialties.

Butterworth & Lowe, of Grand Rapids, Mich., are the patentees of the electric railway specialties illustrated herewith. Fig. 1 is a line hanger, Fig. 2 is a pull off and Fig. 3 is a clamping ear. This firm makes a novel proposition to electric railway companies by offering to allow them to manufacture these devices in their own repair shops by paying royalties based on the number of miles of line owned or operated. The devices are simple, strong and would seem to be easy to make.

——— Redivivus.

To the Editor of Electrical Review:

This notorious fellow has again emerged from a temporary obscurity. He had a few days ago a flaming advertisement of the circus nature in the Boston *Traveler* calling attention to the fabulous returns to be obtained by buying his stock. Here is a sample: "Don't wait a minute. Remit at once." "Parent company's special stock $25 per share, upon which 20 per cent dividend is guaranteed."

Guaranteed, mind you. "By delivering the current from a seven horse-power dynamo to the voltage distributor any number of lamps can be attached and illuminated without overloading the dynamo." As one might naturally ask what new kind of an insect a "voltage distributor" might be, he amiably tells us that, "The voltage distributor is a machine that multiplies electric horse-power without materially increasing the cost of the original source of production." Now, ——— reputation among the electrical fraternity is such that he will pardon us if we ask for time to take breath before accepting any such statement. But this is so sudden.

He evidently feels this, as he now has a Mr. Hart as a con—vert to back up what he says. This Mr. Hart is said to be a lawyer, and, if we do not mistake, a "colonel" also; his statements may therefore be regarded as authoritative on questions relating to electrical science. His opinion will also be valuable on questions as to the boundary line between legitimate business enthusiasm and conspiracy, and the obtaining of money by false pretenses. Some very pretty questions arise in this connection and it is well to be on the safe side of the line. Mr. Hart belongs to an honorable and learned profession, but we really do not know whether to compliment his honesty at the expense of his intelligence or his "smartness" at the expense of his ingenuousness.

Three other gentlemen, engaged in banking pursuits, complete the proprietorship of the Massachusetts State rights. The manifesto says: "The electricians of the ——— company, who have been busy for the past three weeks in erecting a large electric plant at Chelsea, finished their labors a few days ago, and on last Saturday the system was given its first public trial." This large electric plant, it is stated consisted of a 12 horse-power Ideal engine, and a seven-kilowatt dynamo (maker not named). Three of the proprietors then sign and swear to (before a justice of the peace, the other proprietor) a statement to the effect that 150 lamps (said to be 16 candle-power) were operated to their satisfaction for five hours with an expenditure of 500 pounds of coal, which they helped to weigh. We are also told that, "The dynamo is a seven-kilowatt machine having a direct capacity of seventy 16 candle-power lamps, which, as will be seen, was more than doubled when run in connection with the voltage distributor of the ——— system," and that, "Every light above 70 put on a machine of this size endangers the apparatus." This last statement would seem to indicate that it is a ——— seven-kilowatt dynamo. Possibly, however, it is a machine of ordinary make, which an overload of 10 per cent for five hours will not endanger.

Assuming that the lamps were not 10 candle-power lamps run up to say 14 candle-power, 50-watt 16 candle-power lamps are obtainable in the market; 150 of these would take 7,500 watts; allowing an efficiency of the dynamo on full load of 90 per cent and 10 per cent for engine friction, etc., we get 12½ horse-power, and 12½ horse-power for one hour on 100 pounds of coal means eight pounds of coal per horse-power hour, so that the economy in fuel so much enlarged on in the advertisement is imaginary, and the same thing could be done without the voltage distributor.

We must apologize for serious criticism of the ridiculous statements of these people, but it is a fact that people whose cupidity and credulity are in excess of their native "cuteness" are wheedled into investing their dollars in such schemes to the discredit and injury of the electrical industry generally.

When people of this kind state that "Patent No. 534,281 issued by the United States Government on February 19 proves that the ——— company can produce electric light and power so cheaply that no invention can compete with them," it seems time that the unwary should be warned against schemes calculated to bring into disrepute the business of legitimate electric lighting.

We hope we are not doing Mr. ——— an injustice. It may be that when the names of Tesla, Kelvin, Thomson, Edison and others are relegated to the limbo of oblivion, the name of ——— will shine forth in transcendent brilliancy as a genius of the first water—*but not before.*

T. M. Q.

Boston, April 5.

Massachusetts Street Railway Association.

A special meeting of the Massachusetts Street Railway Association was held at Young's Hotel, Boston, April 2, 1895. There was a large number of members present. The following resolutions were adopted:

Whereas, The death of Albert E. Butler has deprived this association of the devoted services of an able and efficient official, who has unselfishly performed the duties devolving upon the office of secretary for a period of years;

And whereas, The members of the Massachusetts Street Railway Association desire to give expression of the appreciation in which his services have been held and of their sorrow for the loss of a friend, therefore, be it

Resolved, That this association realizes its irreparable loss and extends its deep sympathy to his family in their bereavement.

Resolved, That the secretary be instructed to spread these resolutions upon the records of the association and that a copy be sent to his family.

(Signed) E. P. Shaw,
C. E. Barnes,
Benj. J. Weeks,
Committee.

Figs. 1, 2 and 3.—B. & L. Overhead Railway Specialties.

The carrying of mails on the street cars and the watering of streets were the principal topics of discussion, which occupied the most of the evening. An election for secretary and treasurer resulted in the election of C. S. Clark and W. F. Pope for the respective offices.

At the next meeting the subject of mail carrying and the watering of streets will be reported upon by special committees, who will make thorough investigation of the subjects in the meantime.

The meeting was the largest and most enthusiastic that the association has had for some time, and the members manifested much interest in the work of the association.

The officers of the association are as follows: President, John H. Cunningham, of Boston; first vice-president, Amos F. Breed, of Lynn; second vice-president, Frank S. Stevens, of Fall River; third vice-president, John R. Graham, of Quincy; secretary, Charles S. Clark, of Boston; treasurer, W. F. Pope, of Boston.

Executive committee: Alfred A. Glasier, of Boston, chairman; P. F. Sullivan, of Lowell; E. C. Foster, of Lynn; Prentiss Cummings, of Boston; Charles Odell, of Salem; E. P. Shaw, of Newburyport; R. F. Goff, of Fall River; Charles C. Pratt, of Worcester, and the president and vice-presidents.

A METHOD FOR PREVENTING ARMATURE REACTION.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK AND CHICAGO, MARCH 20, 1895, BY HARRIS J. RYAN AND MILTON E. THOMPSON.

(*Concluded from page 183.*)

Fig. 21 is a view of the pole ring. This ring, which carries the six balancing coils, was made in halves, and the pole-pieces were joined together by small connecting lugs as seen in the figure, in order to make the casting continuous. This construction permits the field coils to be wound in a lathe, and to

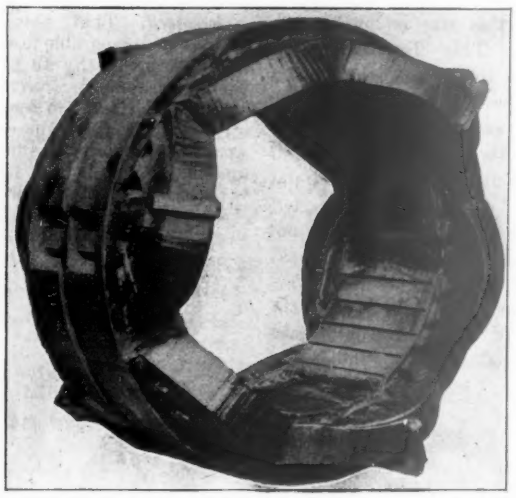

FIG. 21.

be easily removed from the fields at will. It is also a decided advantage to have the balancing coils and the pole-pieces through which they are wound separable from the rest of the field. The following are the more important details of the design of this machine: Capacity, 91 amperes at 110 volts or 10 kilowatts. Type of machine, six-pole, ring field of steel. Armature winding of cable through grooves in core. Armature, 10 inches in diameter outside by 5 inches inside; number of grooves, 61—six conductors per groove. Grooves, seven-thirty-seconds of an inch wide by one and one-fourth inches deep. Number of commutator bars, 122. Total number of conductors, 366. Armature core and pole pieces, five inches long. Mean distance between poles, three-fourths of an inch. Total magnetic flux, 1,800,000 webers. Maximum density in armature teeth, 14,400 gausses. Maximum radial density in armature core, 8,500. Mean air-gap density, 5,000. Maximum field density, 14,000. Length of air gap, one-sixteenth of an inch; M. M. F. for field, 642 gilberts; for air-gap, 1,600 gilberts; for armature, 99 gilberts; total M. M. F., 2,341 gilberts. Fields wound with No. 20 B. & S. G. wire. Armature, 366 conductors of No. 6 cable; five holes in each pole-piece for balancing coils. Balancing coils wound with copper ribbon. Compounding, two series turns on each field coil.

	Pounds.
Weight of field casting, actual	213
Weight of armature core, shaft and spider	98
Weight of armature and commutator complete	185
Weight of armature copper	48
Weight of copper for balancing coils, actual	55
Weight of field copper, actual	40
Weight of dynamo complete, including base bearings, brush holders, brushes and 14x9 inch pulley	865

This machine was completed and tested in October, 1894, and the results of tests were as follows: Speed of dynamo, 1,065 revolutions per minute; voltage, 110. Current, 110 amperes. Time of run, one hour. Temperature of room, 71 degrees Fahrenheit. Temperature of armature, 128 degrees Fahrenheit. Temperature of field, 108 degrees Fahrenheit. Rise of armature, 57 degrees Fahrenheit. Rise of field, 37 degrees Fahrenheit. Field resistance, 110 ohms. Field current, 1.00 amperes. Field energy, 110 watts. Armature resistance, .0512 ohms. Armature winding loss, 618 watts. Balancing coil resistance, .0202 ohms. Balancing coil loss, 242 watts. Series resistance, .00955 ohms. Series loss, 115 watts. Core loss, friction, etc., obtained from energy absorbed as motor running light at full pressure, 450 watts. Total losses, 1,408 watts. Total output, 12,100 watts. Gross energy absorbed, 13,508 watts. Commercial efficiency, 88.7 per cent. For lighter loads the efficiencies are given by the curve in Fig. 21*a*. This test was made after the machine had been running for several hours under various loads. On another occasion the machine ran one hour and 20 minutes under a load of 115 amperes at 105 volts with a rise of temperature of armature of 48 degrees Fahrenheit. While carrying this load, which it will be noted is 25 per cent above the rated full load, the pilot brush exploration curve, shown in Fig. 22, was taken. This curve shows the entire absence of armature reaction. The machine has also carried 135 amperes for one-quarter hour, and has several times been loaded down to 180 amperes for a few minutes at a time without damage.

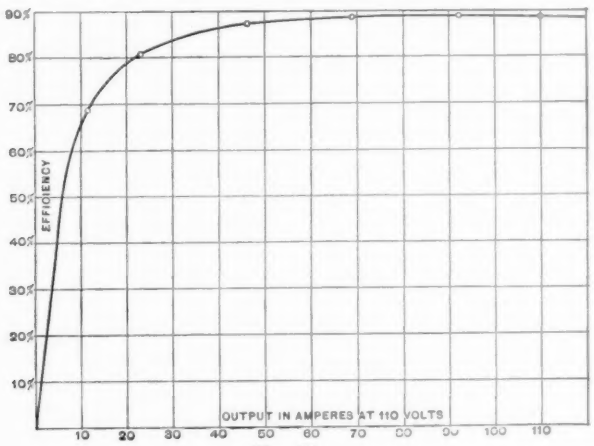

FIG. 21a.

While the "balancing coils," as may have been seen from the foregoing results, entirely prevent field distortion and shifting of the neutral point, there is still something lacking for ideal commutation. In a constant potential dynamo, the following are the conditions for perfect and sparkless commutation. When a coil is short-circuited as it passes under a brush, the current in the coil must fall to zero, reverse and rise exactly to the original value in the opposite direction at the instant the short-circuited coil is opened by the passage of the tip of the brush from the commutator bar. To bring about this reversal properly, the short-circuited coil must move during short-circuit through a field whose strength is proportional to the armature current. In other words, the short-circuited coil should move in a neutral field when the machine is unloaded and should move in a field of considerable strength when fully loaded. The field strength required for sparkless commutation under any particular load depends, first, on the resistance of the short-circuited coil; second, the self-induction of the short-circuited coil, and third, the duration of the short-circuit, which, in turn, depends on the width of brush and speed of the dynamo. Preferably, the short-circuited coil should move in a uniformly distributed field. It is evident from this consideration that we do not get the conditions for perfectly sparkless commutation, even where armature reaction is prevented, if we attempt to commutate under pole corner. It is also evident that if armature reaction and field distortion are not prevented we get just the opposite effect on our commutation from what we would wish; that is, our commutation field grows weaker as the current increases, instead of growing stronger as it should. From this we may set it down as a settled fact that no dynamo of any considerable voltage and range of capacity, which commutates under the leading pole corner and is not provided with some special spark-preventing device or arrangement for preventing field distortion, can be worked from no load to full load without sparking or without shifting the brushes. During their experimental work on balancing armature reaction, the writers devoted considerable time to the problem of sparkless commutation, and as a result have devised an improvement to be used in connection with balancing coils, by means of which ideal commutation is attained. The device is simple, and accomplishes the desired end perfectly. It consists in bridging across the gap between the pole-pieces, attaching a commutation lug to the center of this bridge and making this lug the center of the balancing coil, the latter being provided with a few extra turns. The arrangement is shown in Fig. 23, which represents a portion of the field circuit sectioned centrally in the plane of rotation. Referring to the figure, *aa* and *bb* are two field coils wound round the pole necks *c* and *d*; *g* is the commutation lug which is attached to the middle of the lugs *h*, *i*, which latter bridge across the gap between the pole-pieces *e*, *f*. The balancing coil (not shown) is wound through the holes *k*, *l*, *m*, *n*, *o*, *p*, with the commutation lug *g* at the center of the coil. The path for magnetism is indicated by the dotted lines. It will be noticed that a part of the magnetic lines are shunted across between the pole-pieces *e* and *f*, through the bridge lugs *h*, *i*, and do not pass through the armature. Now when there is no current in the armature or balancing coils, it may be easily seen that the fall of magnetic potential from *e* to *f* is the same by either the path through the bridge lugs, or through the armature, and that the commutation lug *g* attached to middle of the bridge lugs must be at the same magnetic potential as the armature teeth opposite, for the latter are connected to the middle of the armature circuit. Therefore, under these conditions, which are practically what we have when the machine is running light, there will be no field between the surfaces *r* and *s* of the commutation lug and armature, respectively. If, then, our brushes are set so that commutation takes place while the short-circuited coil is passing under the commutation lug, we have the correct

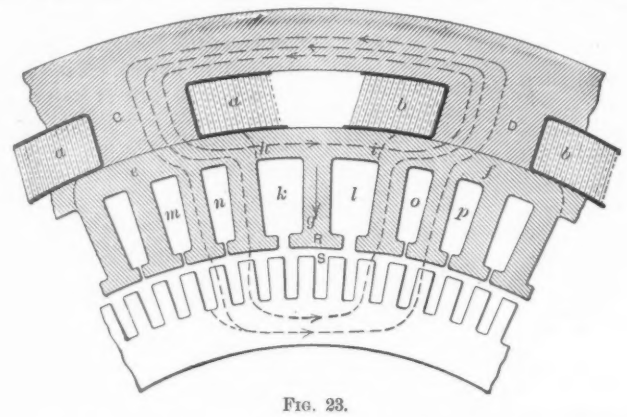

FIG. 23.

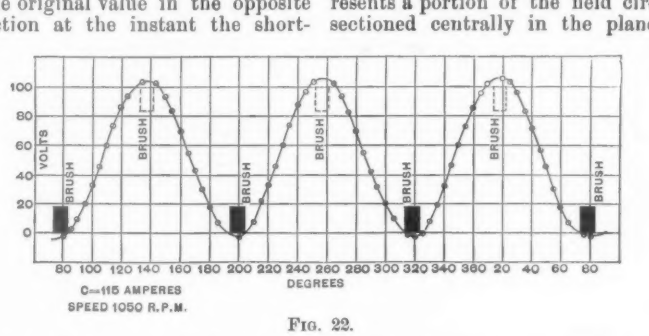

FIG. 22.

conditions for sparkless commutation. When the machine is loaded, the excess of ampere turns of the balancing coils over ampere turns of the armature, brings a magnetizing force to bear on the lug *g* in the direction indicated by the arrow. This tends to increase the magnetism through *h* and diminish it through *i*; but as *h* is normally saturated, there will be very little increase in its magnetism. There will, however, be a field established under the commutation lug by the deflection of the lines from the lug *i* through the commutation lug and armature, and it is evident that the stronger the current in the balancing coils, the stronger will be the field under the commutation lug. We, therefore, again have the correct condition for sparkless commutation when the machine is loaded, provided our balancing coils are so proportioned as to give us a commutation field of proper strength. From this it will be seen that at all times the commutation field is proportional to the current, and that for all loads we have the requisite conditions for sparkless commutation without shifting the brushes.

So much for the theory of this plan, and now comes the important question "Will it work in practice?" We are able to answer without hesitation that such a machine performs as well in practice as in theory, and that actual tests show absolutely sparkless commutation from no load to 50 per cent overload with fixed metallic brushes. More than this, practice confirms another theoretical advantage of this improvement which we have not yet touched upon. It will be noticed that the commutation field is obtained by the deflection of lines from bridge lug *i* and that the lines so deflected pass through the armature and consequently are added to the useful magnetic field. We might expect from this, and from the fact that since the brushes are midway between the poles, there are no back ampere turns, that the machines would compound somewhat without a regular compound winding. This theory was entirely sustained by actual trial. It was found under test that by slightly shifting the position of the brushes forward or backward it was possible to make a few of the armature turns act with, or against the field winding at will, and this without any effect on the sparkless commutation, so long as the brushes were not moved beyond the limits of the commutation field. The result of this is that by simply shifting the brushes the compounding of the machine may be so changed that it can be adjusted at any point from 10 per cent drop to 10 per cent overcompound, and this without interfering with the commutation in any way.

Thus, by this simple contrivance, we attain sparkless commutation without shifting of brushes and a compounding adjustable at will. It is not claimed that the broad idea of a commutation lug is new, but the success of such a contrivance depends altogether on the way in which it is applied. Unless the magnetic effects of the armature currents are taken care of properly, a commutation lug would prove worse than useless and we would be likely to get an effect just the opposite of that desired. Thus it will be seen that the advantages, which we have shown as resulting from the use of this system of commutation, arise not from the use of a commutation lug alone, but from its use in connection with coils for balancing armature reactions. Direct experiment has shown that this system of commutation will not give satisfactory results except when used in connection with balancing coils. Aside from the effect on commutation, however, balancing coils have some very important advantages to which we will briefly call attention. By their use the capacity of a machine of given size and weight may be greatly increased, and the resulting machine still be far better in quality and operate more satisfactorily than those of ordinary design. The reasons for drawing this conclusion are briefly these: Since the output of these machines is in no degree limited by armature reaction, it is possible to load the armature with as much copper as can be crowded onto it and to work this greatly increased amount of copper to its safe heating limit—the heating of the armature conductors being the only limit to the capacity of a given armature; and the core losses may be much less in a machine of this type since the magnetic densities in the core may be made as low as we choose, and this will permit the armature to be loaded with still more copper.

With the standard peripheral velocity of 3,000 feet, it is easy to get an output of 20 to 30 watts per pound total weight of dynamo, and for large sizes of machines even still greater output per pound. With armature reaction balanced, there is no necessity for high reluctance in air-gap and teeth, and it is, therefore, made as low as possible for the whole magnetic circuit. The air-gap is reduced to what suffices for clearance, and the armature and field are worked at as low densities as is consistent with economy of iron. By this means from one-half to three-fourths, or even more, of the ampere turns on the field may be saved with a corresponding saving in field copper and field energy. This and the reduced core losses reduce the fixed losses in the dynamo to a minimum, bringing them below what is possible with the ordinary construction, and the result is a very material change in the shape of the efficiency curve of the machine. Since the fixed losses are very small, the machines will have unusually high efficiency on light loads, the efficiency curves run up very sharply and bend off to a very uniform efficiency throughout the greater part of the range of load. This is a very decided advantage where machines are expected to work under considerable range of load, as they usually are, both for lighting and power purposes. In designing machines it is also an easy matter to proportion materials according to their relative prices. Thus, with a design containing a given amount of copper, we can increase the copper slightly and reduce the iron and steel, keeping the capacity of the machine the same, and thereby effect a saving in cost, perhaps; or we may increase the iron and steel and reduce the copper to effect a similar saving. With ordinary designs such an adjustment as this would be out of the question, except at a sacrifice of valuable qualities of the machine, for the invariable rule is that the M. M. F. of the armature ampere turns may never exceed the M. M. F. impressed by the field between the pole faces.

The value of sparkless commutation is almost beyond price. Commutation has always been recognized as the greatest bugbear of continuous-current machinery. Whatever adds to the life of the commutator adds to the durability of the machine, and the prevention of sparking is, therefore, an important feature. To be able also to have the brushes permanently fixed is of decided value, and this, when taken with sparkless commutation, makes a dynamo self-attendant to a greater degree than usual. The extra cost of applying these improvements to a dynamo is far more than balanced by the saving effected in materials, and the writers believe that the application of these methods of design in dynamos would make a pronounced and important step towards the practical perfection of this class of machinery.

Telephone Linemen and Tin Roofs.

To the Editor of Electrical Review:

I notice an item going the rounds of the press to the effect that telephone linemen are particularly destructive to tin roofs of buildings by reason of cutting through the tin by walking thereon while wearing their climbers or spurs. This is a prevalent misapprehension without due examination or consideration and is accepted as an easy explanation by tin roofers who may have been sent by property owners to examine leaky roofs. The fact is, and can be easily demonstrated by any one who may take the trouble, that it is an impossibility for a lineman wearing spurs to reach the tin of a roof while standing erect. The only way in which he can cut the tin is by lying flat thereon, and so making a special effort to pierce the tin with the gaff. I am certain that nearly all damaged tin roofs are the result of careless and ignorant workmen who go thereon to remove snow and ice, using shovels, axes, or other sharp tools.

Many roofs suffer by reason of metals, such as nails or wire clippings, which quickly corrode holes through the tin. A good broom, timely used, is the obvious remedy as a preventative.

B. M. R.

Williamsport, April 2, 1895.

PERSONAL.

Mr. H. Durant Cheever, of the Okonite Company, Limited, has gone to Europe.

Mr. J. H. Rhotehamel, of the Columbia Incandescent Lamp Company, St. Louis, is visiting New York.

Mr. John C. Knight, of New York city, who is well known in the electrical field and is the inventor of the Knight arc lamp, sailed for Europe last Saturday on "La Bourgogne" for a two months' vacation in Europe.

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Official Notice No. 46.

(PUBLISHED BY AUTHORITY OF THE COMMON COUNCIL OF THE CITY OF SHEBOYGAN.)

NOTICE TO ELECTRIC LIGHT CONTRACTORS.

Office of Board of Public Works, }
Sheboygan, Wis., March 23, 1895. }

Sealed proposals will be received at this office until April 29, 1895, at 3 o'clock P. M., for lighting the streets of the city of Sheboygan for the term mentioned hereinafter, upon the following conditions:

I. Price per lamp per year, for 128 or more Electric Arc Lamps, of full 2,000 candle-power, to burn every night in the year from 30 minutes after sundown until 30 minutes before sunrise.

II. The entire plant to be of the safest and most approved pattern and quality, and every reasonable precaution taken to guard against danger and damage to persons and property.

III. Each bid to be accompanied by a bond or deposit of Five Thousand Dollars ($5,000.00), conditioned upon the bidder promptly entering into a contract, should the contract be awarded to him, and in case a bond is given the same must be executed by sureties living within this State who shall justify in at least twice the amount of the bond.

IV. The Board to reserve the right to reject any and all bids.

V. All poles, wires and lamps to be erected under the supervision and approval of the Board of Public Works.

VI. The time and place of opening the bids, April 29.

VII. Separate bids to be made for the terms of 5, 10, 15 and 20 years.

All bids must be stated in writing and in figures, otherwise they will not be considered.

All money deposited will be returned to unsuccessful bidders on award of contract, and to successful bidders when contract is entered into.

The Board reserves the right to reject one or all bids.

H. J. WEIGAND,
PAUL T. KREZ,
FRED ROSENTHAL,
Board of Public Works.

Countersigned
JOHN SCHMIDT, Compt.

NOTICE.

We are anxious to extend the trade for our Dynamos and Motors among Electric Power and Railway plants.
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KINDRED INTERESTS

James Boyd & Brother, 14 North Fourth street, Philadelphia, have issued a very handy and complete catalogue of electric railway equipment and supplies. The overhead material described is of the highest quality, both as to the insulation and the metal.

The Mather Electric Company, of Manchester, Conn., has just closed a contract with the Berlin Iron Bridge Company, of East Berlin, Conn., for equipping their new forge shop with electric power. A 40-kilowatt generator and a 50 horse-power motor will be used.

Frank H. Stewart & Company.—The electrical supply business heretofore conducted by Frank H. Stewart at 20 North Seventh street, Philadelphia, will be continued at the old stand under the firm name of Frank H. Stewart & Company, Mr. P. Logan Bockius having been admitted as a partner.

Chas. E. Chapin, 26 Liberty street, has been appointed selling agent for the Norton voltmeters and ammeters. Mr. Norton made these instruments for two years under the direction of Professor Anthony. The instruments are finished in polished brass and present an elegant appearance. Mr. Chapin will carry a stock for immediate delivery.

The Royal Electric Company, of Peoria, Ill., has completed arrangements with Messrs. H. B. Coho & Company, 203 Broadway, New York city, to handle their alternating current apparatus in the East. Messrs. Coho & Company have secured the services of Mr. George C. Hoffman, formerly of the Westinghouse company, who will have charge of their alternating current department.

The Partrick & Carter Company, 125 South Second street, Philadelphia, has issued its 1895 catalogue of house goods and general electrical supplies. It's a beauty, too. Everything covered by the title is enumerated in this catalogue, the line of hotel and other annunciators being especially complete. Write for a copy of this catalogue whether you need it just now or not. It will be sent free if you mention the ELECTRICAL REVIEW.

The Mather Electric Company, of Manchester, Conn., reports the sale, through its well-known western contractor, J. Holt Gates, of Chicago, of two 65-kilowatt new type direct connected generators for Fort Dearborn Building, Chicago, also, the sale of two 50-kilowatt direct connected generators for the Lauderdale Building, Providence, R. I., also, one 85-kilowatt 220-volt generator to the Walter Ferris Coal Company, Salem, Ohio, and two 30-kilowatt new type multipolar generators in the station of the Catasauqua Electric Light and Power Company, Catasauqua, Penn. These two generators are of the Mather Company's latest type, and their speed does not exceed 300 revolutions per minute.

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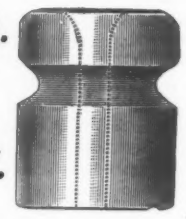

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NOTICE OF RECEIVER'S SALE.

Electric Light Plant.

Notice is hereby given that the undersigned, Receiver of all the property and estate of the Hammond Light and Power Company, of Hammond, Indiana, heretofore appointed by the Lake Circuit Court of said State, will offer at public sale, to the highest and best bidder, upon terms hereinafter expressed, on the 25th day of April, 1895, at 10 o'clock A. M., at my office in the said city of Hammond, the following property, to wit: All the property, rights, franchises, privileges, plant, power house, power plant, engines, dynamos, machinery, boilers, poles, wire and all fixtures and appliances owned by said Hammond Light and Power Company, including as well franchise from said city of Hammond, and its franchise from the commissioners of Lake county, and also its Real Estate, being Lots 21, 22 and 23, in Block 17 of east part of North Side addition to the town (now city) of Hammond, Lake county, Indiana; excepting, however, all choses in action, book accounts and other accounts and bills receivable of the said company. Said property to be sold subject to a mortgage indebtedness of $30,000, and for not less than $15,000. A deposit of $2,000 in cash or certified check for that amount shall be required of each bidder before receiving bids, said sum to be applied to the purchase price of successful bidder, and the deposit of other bidders returned to them at once. The further sum of $5,000 to be paid Receiver upon confirmation of sale by said court, and balance of purchase price to be paid 45 days from the date of confirmation of such sale. Said sale to be made in conformity with the order of said court, entered March 8, 1895. Address all inquiries to the undersigned.

ADELBERT W. WARREN, Receiver.

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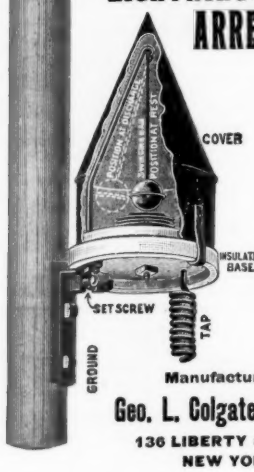

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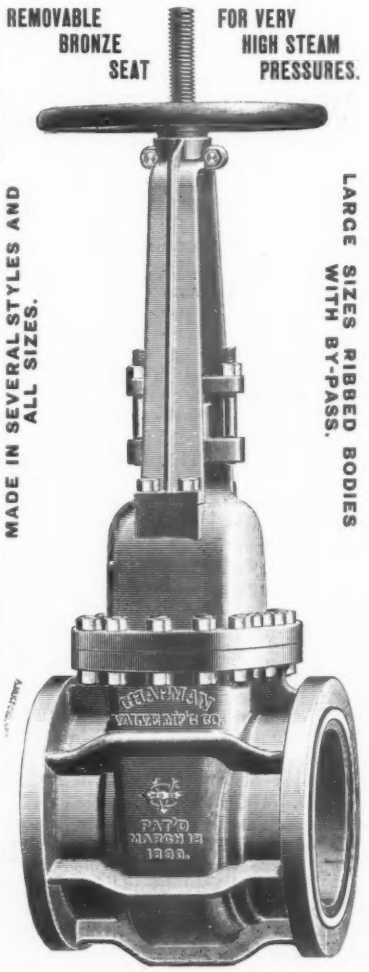

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